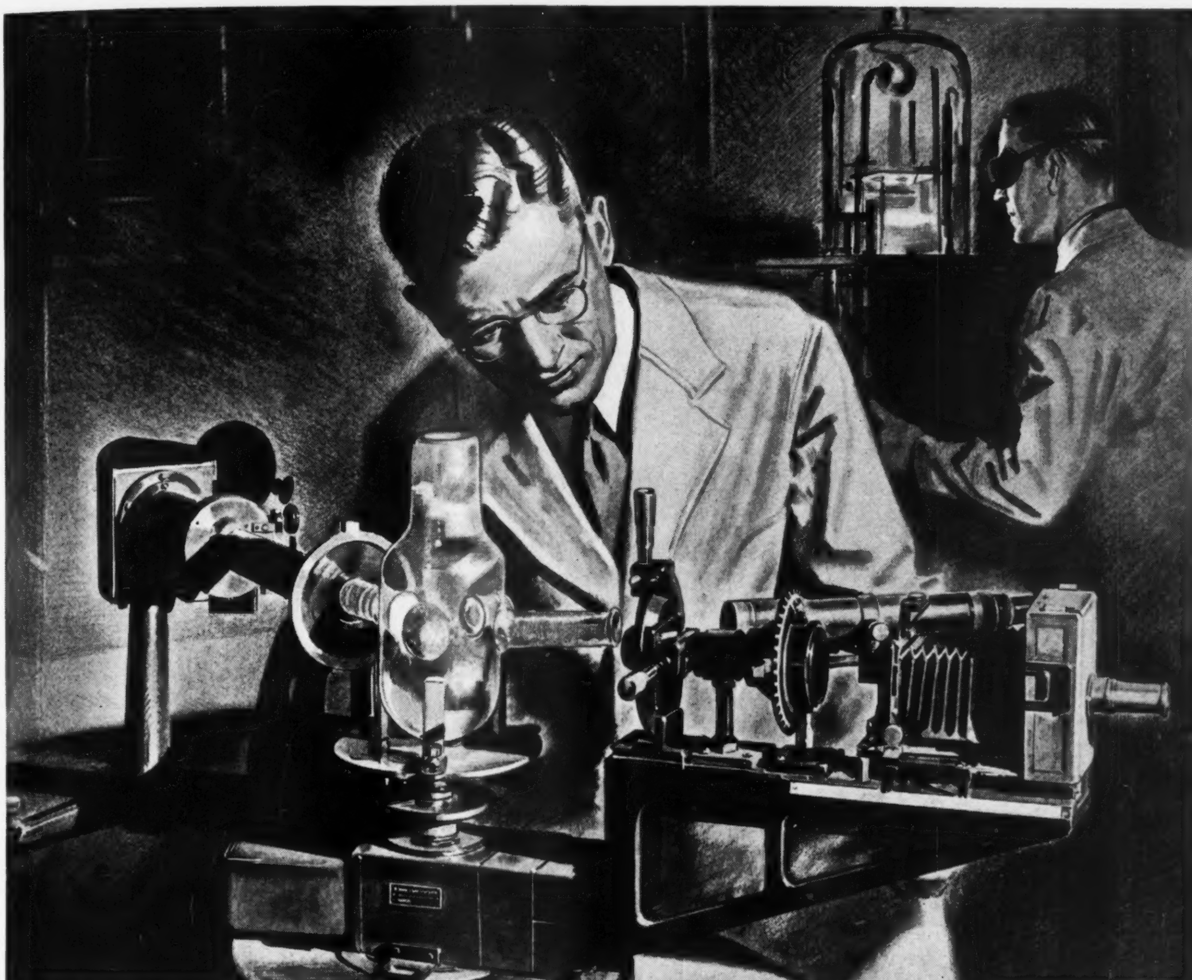
BELL LABORATORIES RECORD



An artist's representation of one of our photoelectric laboratories

JULY 1941 VOLUME XIX NUMBER XI

A Test Set for Pulse Repeaters

By A. S. MARTINS
Switching Development Department

The method, which has been employed for checking the pulsing performance of interoffice repeaters, was to observe the action of the associated incoming selector in the distant office as pulsing test conditions were applied to the subscriber side of the repeater. This is subject to certain inaccuracies because of the variability of the pulsing ability of the incoming selectors; a particular incoming selector may operate satisfactorily whereas the succeeding switches in the train may fail with the same pulses. In addition, the method makes no provision for departures of central-office voltage from normal level.

In step-by-step multi-office areas, pulse repeaters are generally employed on interoffice trunks. They receive the pulses from the subscriber's dial and transmit corresponding pulses over the trunk conductors to the called office. Each pulse repeater is usually associated with a particular trunk and is adjusted for the normal impedance of the trunk. The character of the pulse delivered to the incoming selector at the distant office, however, depends not only on the trunk impedance but on the adjustment of the subscriber's dial, the impedance of the subscriber's loop and the central-office voltage. Tests must be made on the repeater from time to time, therefore, to make sure that it is delivering proper pulses to the distant selector under all conditions encountered in service.

With improvements in the transmission performance of the station set, which have permitted the use of trunks and loops of higher resistance, a need has been felt for more accurate means of maintaining pulse-repeating circuits. As a result a pulse-repeater test set has been developed. It is shown in use in the photograph at the head of this article. With this set, a maintenance man at an outgoing office can adjust repeaters with very little assistance from the distant office, and get the best possible adjustment for operating the switches at the distant office.

The pulses sent over a trunk operate the A relay of the incoming selec-

tor associated with the trunk at the distant end. The new test set includes the equivalent of one of these A relays, and also in series with it resistances which can be adjusted to equal the resistance of the trunk associated with the repeater to be tested. By sending pulses of known characteristics into the repeater to be tested, and connecting the output of this repeater to the test set, the A relay in the set will respond just as would the A relay at the end of the trunk, since it has in series with it an impedance equal to that of the trunk circuit.

The characteristic of the pulse that is of particular importance is the relative duration of its closed and open portions and the test circuit determines this by using a per cent-break meter to indicate the per cent of time that the A relay is released while pulsing. The moving element of this meter has sufficient mass so that the pointer remains essentially steady when the direct current applied to it is interrupted at rates corresponding to the extreme range of dialing conditions. The pointer thus remains steady under test pulsing, but its deflection will be determined by the time integral of the current received, and will thus be proportional to the percentage of time that the pulsing contact is closed. The scale has fifty divisions numbered from 0 on the left to 100 on the right. With no current flowing through the meter, the pointer rests at the 100 per cent mark, and thus

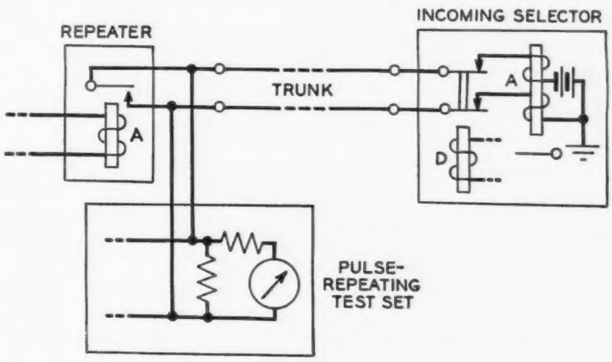


Fig. 2—Circuit connections while trunk resistance is being measured

the reading gives the per cent open period of the dialing contacts.

In making a test, the set is connected to the trunk at the output of the repeater. A key in the set permits the circuit to be arranged so that the resistance of the trunk may be measured, and then so that the resistance in the set may be made equal to it. The incoming selector at the distant office is then disconnected, and a pulsing test set is connected to the input of the repeater to supply the test pulses. By restoring the key to normal, the connections of the repeater test set are changed to allow the pulses from the repeater to operate the pulsing relay in the set over an impedance equal to that of the trunk. A contact on the set's A relay

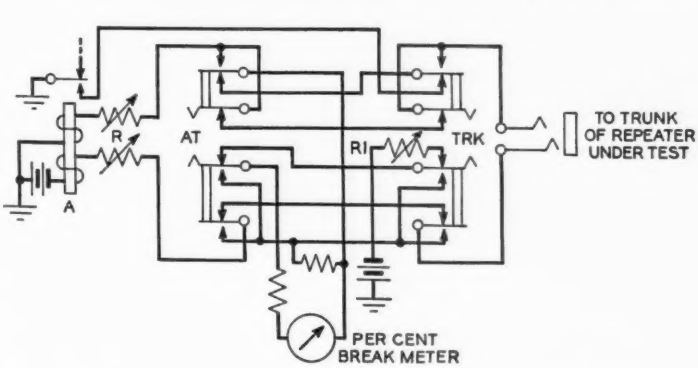


Fig. 1—Simplified schematic of pulse-repeater test set

makes and breaks a circuit to the per cent-break meter, which indicates the nature of the received pulses. The repeater is then adjusted as the results indicate desirable.

A simplified schematic of the circuit of the test set is shown in Figure 1. When the key is operated to the TRK position, the circuit becomes as shown in Figure 2. No pulses are sent into the repeater, but battery from the distant office causes current to flow through the A relay of the incoming selector, the trunk and the meter of the test set, which under this condition is employed as an ammeter. The meter deflection is noted, and then the key is operated to the AT position. This disconnects the set from the trunk, and changes the connections to those shown in Figure 4. The series resistances are adjusted until the same meter reading is obtained. The resistance of the A relay and series resistance of the test set are then the same as that of the trunk and of the A relay at the distant office, since the central-office battery is used in both cases and any voltage difference that exists is minor.

After this adjustment has been made, the key is returned to the normal position, establishing the connections shown in Figure 3. The pulsing test set can then send pulses to the repeater, which repeats them to the A relay of the test set through resistance R. The trunk, although open at the distant end, remains connected

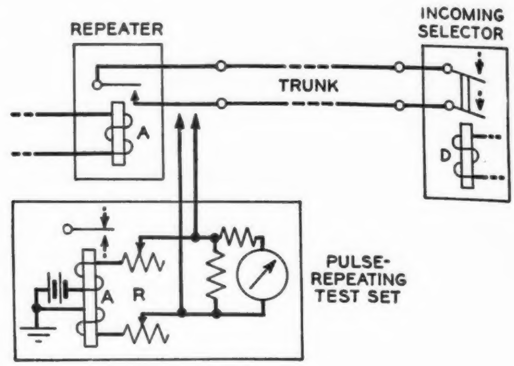


Fig. 4—Circuit connections while the resistance in the set is being adjusted to equal that of the trunk

across the repeater, and thus the effect of shunting capacitances or leakages of the trunk remain. This insures that the pulsing under test conditions is the same as under operating conditions. One side of the meter is connected to battery through an adjustable resistance R1, and the other side, to the contact of the A relay of the test set. R1 has been previously adjusted so that the meter reads 0 per cent break when the contact of the A relay is held closed. Under test conditions, therefore, it correctly records the per cent-break of the contact of the A relay. If the per cent-break falls within specified limits when the extreme subscriber line conditions are applied by the pulsing test set, the repeater is satisfactory. If not, adjustments are made and further tests are then made.

This method of maintain-

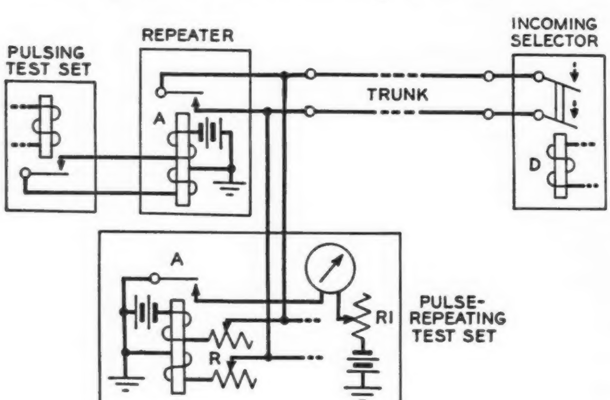


Fig. 3—Circuit connections while measuring characteristics of pulses sent out by the repeater

ing pulse repeaters within specified per cent-break limits results in minimum pulse distortion on the particular trunk involved. It is particularly desirable to take advantage of this reduction in distortion in areas where steps are being taken to obtain increased ranges for subscriber dialing, or where the resistance of the trunk conductors approaches the maximum limit. The increased tendency towards "built-up" connections between step-by-step offices, which require several repeaters to operate in tandem, has also emphasized the necessity of applying per cent-break adjustments with the pulse-repeating test set. When pulsing difficulties are encountered on calls routed through several central offices, it is difficult for the maintenance men to localize the cause of the trouble. With the pulse-repeating test set, however, it is possible to check the pulsing performance of the various circuits in the connection, either individually or in combination to disclose the repeater circuit that is causing the trouble.

TO THE CONGRESS OF THE UNITED STATES:

One of the greatest resources in the arsenal of Democracy is our national ability and interest in Industrial Research. For the vigorous prosecution of our defense program and for the assurance of national progress after the emergency we rely heavily on the continued vitality of research by industry in both pure and applied science.

Our people can justly take pride in the record of the accomplishment by American industry contained in the report on "Research—A National Resource, Part II, Industrial Research" which I am transmitting for the information of the Congress. . . .

The report presents a clear record of how successfully we have translated our old-time Yankee ingenuity for invention into American genius for research. Our scientists have uncovered and explained the secrets of nature, applied them to industry, and thus raised our standard of living, strengthened our defense and enriched our national life. . . .

I commend a careful reading of this report to the Members of the Congress.

FRANKLIN D. ROOSEVELT.

The report transmitted with the message quoted above was prepared by a committee of the National Research Council, of which F. W. Willard, President of the Nassau Smelting and Refining Company, was chairman. Among members of the committee were F. B. Jewett, O. E. Buckley, and R. R. Williams. The chapter on Mathematics in industrial research was written by T. C. Fry.

Temperature Stability of the 2B Pilot Channel

By D. B. PENICK
Carrier Telephone Development

TRANSMISSION regulation is an important factor in maintaining high standards of communication in the telephone system. This is especially true for carrier circuits. With a single pair of wires providing a number of telephone channels, the load-carrying capacity of amplifiers, modulators, and other components must be carefully related to the speech volumes, and the transmitting levels held closely to established values to meet the required standards of crosstalk, modulation and noise. In the type-C carrier system, this regulation may be accomplished automatically—during normal weather conditions—by the 2B pilot channel,* which adjusts the transmission level at the output of each amplifier in accordance with the level of a pilot frequency transmitted over the line from an oscillator at one end.

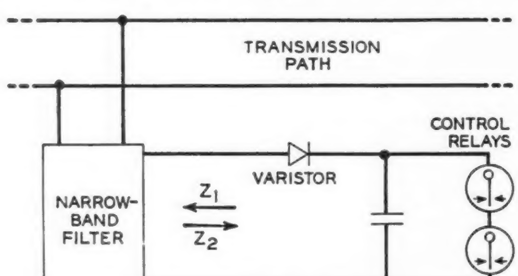


Fig. 1—Simplified schematic of control circuit to study temperature stability

The closeness with which the desired transmission can be held under normal weather conditions depends primarily on how nearly the output of the oscillator can be held to the desired value, and upon variation in the sensitivity of the control circuit that adjusts the level at each amplifier. Both oscillator and control circuit may vary in their behavior under the influence of a number of factors, chief of which is temperature. As now provided in the 2B pilot channel, the oscillator output, with all variations in temperature and battery voltages, is constant within 0.25 db.

The earliest experimental models of the pilot-control circuit were found to vary over a range of 2.5 db as the temperature varied from 60 to 110 degrees Fahrenheit. A variation of this amount was too high, and a study was made to determine its causes.

The essentials of the control circuit are shown schematically in Figure 1. A narrow-band filter* bridged across the transmission path selects the pilot frequency and sends it into a varistor-rectifier, which converts it into direct current to operate the relays controlling the regulating equipment and thereby the transmission level. These relays have a high resistance, which is nearly the whole resistance of the d-c circuit. Since they are wound with copper wire, their resistance increases with temperature at the rate of about 0.22 per cent per degree Fahrenheit, a total variation of 11 per cent within

*Record, *Feb.*, 1941, *p.* 180.

*Record, *June*, 1941, *p.* 323.

the normal range of room temperatures, which is taken as 50 degrees Fahrenheit. If the rest of the circuit is held at constant temperature, this variation alone amounts to about 0.4 db in overall sensitivity.

A typical varistor, measured at a frequency of 24.35 kc, varies in sensitivity as shown in curve A of Figure 2 when the temperature is changed. In the room-temperature range, the variation is about 0.3 db, but opposite in sign to the change due to the relays. Since these two variations oppose each other, the net rectifier variation, curve B of Figure 2, is small, in the neighborhood of 0.1 db. The condenser of Figure 1 is used to secure maximum output from the varistor, and is so large that its temperature changes have negligible effect on the sensitivity of the circuit.

An average filter measured between constant impedance terminations varies in loss at the pilot frequency about 1.3 db over the temperature range, increasing in loss with increasing temperature. This is shown in curve C of Figure 2. The sum of these individual variations still accounts for only about half of the observed 2.5-db variations mentioned above. The remainder, therefore, must be due to an interaction effect between the filter and the rectifier.

The key to this effect is found in the behavior of the rectifier impedance with changes in temperature, and in the relation of this impedance to that of the output of the filter. A fundamental transmission principle is that the maximum transfer of energy from a generator of impedance $Z_1 = R_1 + jX_1$ to a load of impedance $Z_2 = R_2 + jX_2$ occurs when $R_1 = R_2$, and $X_1 = -X_2$. In other words, the resistance components of the two impedances should be equal, and the reactance components should be equal but of opposite sign. When these conditions do not exist, there is a transition loss.* So far as stability with temperature is concerned, this transition loss need not be zero; it is essential only that it remain constant with changes in temperature. If, however, either $R_1 + R_2$ or $X_1 + X_2$ varies with temperature there will be a variation in transition loss, and thus a change in the sensitivity of the circuit.

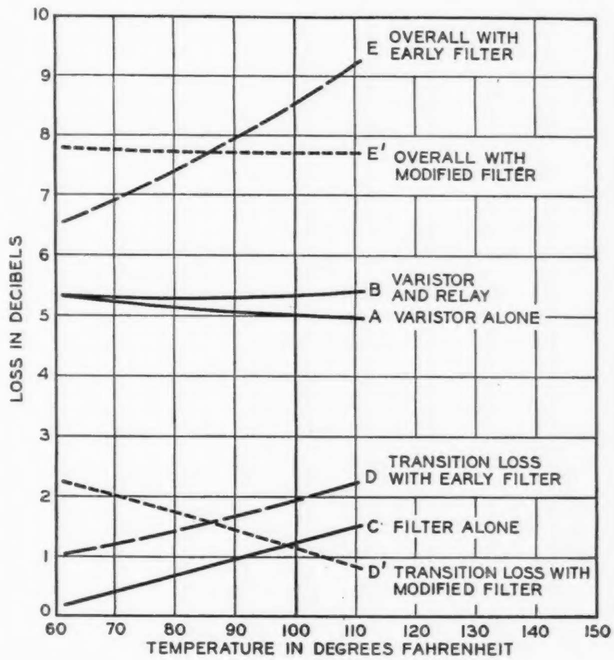


Fig. 2—Variations in loss over the range of room temperatures of various elements and combinations of elements of the regulating control circuit

The resistances of both filter and varistor, although not equal, are essentially constant with tempera-

*In db equal to $10 \log \dfrac{(R_1+R_2)^2 + (X_1+X_2)^2}{4R_1R_2}$.

ture, and thus do not contribute to any variation in transition loss. The reactance component of the original filter was also constant, and equal to about +2800 ohms. The reactance component of the rectifier, however, was negative and varied with temperature as shown in Figure 4. Since these two reactances are of opposite sign, their algebraic sum, which enters the equation for transition loss above, is equal to their numerical difference, and to make the value of this difference more obvious, the negative of the filter reactance is also plotted in Figure 4. Since this difference increases with temperature, the transition loss also increases with temperature, and is shown as curve D in Figure 2 as calculated from the formula. The sum of the ordinates of curves B, C, and D of Figure 2 thus gives the overall loss of the complete rectifier in combination with the filter, and this loss is shown by curve E.

The change in transition loss, it will be noticed, is about half the total loss, and thus accounts for that part of the total loss that was not accounted for by the filter and varistor losses above. If the slope of this curve of transition loss could be reversed, that is, if the loss could be made to decrease with temperature rather than increase, the total of all the losses would then remain about constant with temperature. Had the filter reactance been numerically less than the rectifier reactance—in other words, had the curve of the negative of the filter reactance lain above the curve of rectifier reactance that is shown in Figure 4—this condition would have been met.

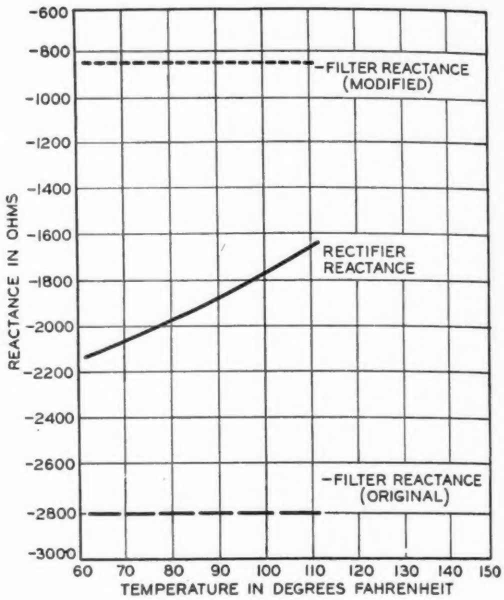


Fig. 4—Variation in reactance with temperature of rectifier reactance and the original and modified filter reactances

It was thus obvious that a high degree of stability could be secured by decreasing the filter reactance sufficiently to make it less numerically than the rectifier reactance. The output impedance of the selective circuit of the filter is actually very much lower than that of the rectifier, and in the original circuit an auto-transformer had been used to step the output impedance up to the 2800 ohms. To make this impedance lower, as now seemed desirable, a different auto-transformer could have

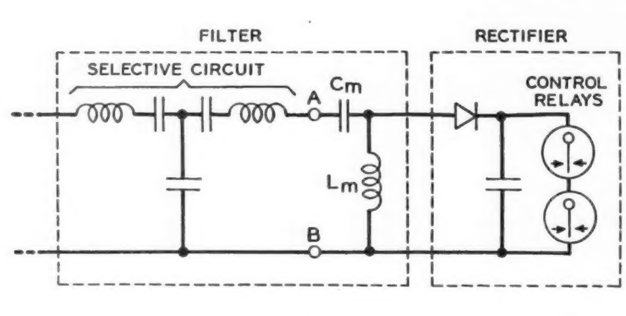


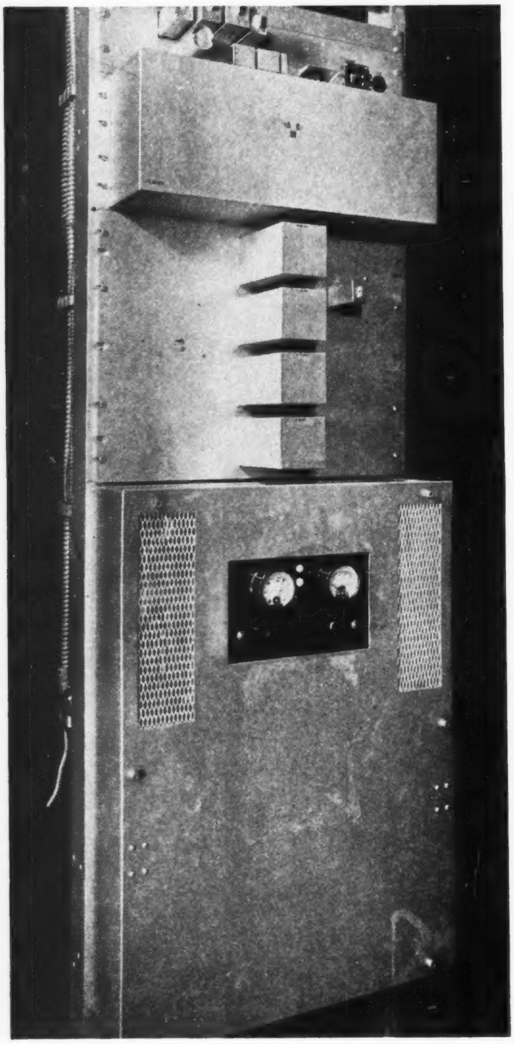
Fig. 3—Schematic of filter and rectifier showing C_m and L_m used for impedance transformation

been designed. It seemed simpler and more economical, however, to add the reactance elements C_m and L_m to the filter, as shown in Figure 3. These do not affect its selective action but modify the reactance of the filter as seen from the rectifier. They provide the proper impedance transformation because a capacitance and inductance, tuned to resonance, present a low impedance when they are in series and a high impedance when they are in parallel. It will be noticed from Figure 3 that C_m and L_m are in series with respect to the selective circuit, and thus present a low impedance to match the low impedance of the selective circuit. They are in parallel with respect to the rectifier, however, because the very low impedance of the selective circuit has the effect of connecting the A terminal of the capacitance to the B terminal of the inductance through a low impedance. The choice of values for L_m and C_m must be guided by the fact that the rectifier is in parallel with L_m, that the selective circuit is in series with C_m, and that the desired output impedance of the filter must be inductive. A more detailed consideration of these factors gave suitable values for these circuit elements. The modified transition loss secured is shown by curve D′ of Figure 2, and the overall net loss—the sum of B, C and D′—is shown by the curve E′. With the modified filter the total change in loss with temperature is only 0.1 db.

At the pilot frequency, the effectiveness of the stabilization under service conditions is indicated by continuous recorded measurements which have been made of transmission level on a typical, short, type-C system regulated by a 2B pilot channel. The maximum observed deviation was about ± 1 db. Half of this deviation is inherent in the method of regulation, since no regulation takes place until the level is 0.5 db higher or lower than normal. The remaining deviation of ± 0.5 db, then, includes the variations of both pilot supply and control circuits as well as other small variations.

Commercial Service Over Coaxial Cable

On June 9 the coaxial cable between Stevens Point and Minneapolis became part of the nation's communication system. This cable is two hundred miles long, and cost $2,500,000. It contains four coaxial tubes, set up to form two complete paths of which one is in use, the other in reserve to be switched in automatically in case of trouble. Terminal facilities have been installed for 48 circuits which will be put in service as the load requires. Between terminals there are 37 repeaters, most of them unattended. Total gain under average conditions is about 2400 decibels



Electronic Inverter for Interim Power Supply

By D. E. TRUCKSESS
Power Apparatus Development

POWER for the repeaters of the coaxial, or L, carrier system is transmitted as alternating current over the coaxial cable itself. At terminals and main repeater stations this power is supplied from commercial power lines; and gasoline engine alternators are provided to carry the load should the commercial power supply fail. If this were the only precaution taken, however, there would be an interruption of communication for the few minutes required to get the emergency generator started. To bridge this gap between the failure of power and the starting of the emergency generator, and to carry the load over short-time failures of power, the Laboratories has developed an electronic inverter, which will take over the alternating-current supply within a few cycles after the failure occurs. On restoration of the a-c source, the inverter will transfer the load back to it within a slightly shorter interval. It is not proposed to have the inverter carry the load except for short periods; its primary purpose is to prevent an interruption of communication while an emergency generator is being started or over a short outage.

The essential elements of an inverter are shown in Figure 1. The a-c mains are connected to the plates of two thyratron tubes through a transformer, and the positive of the station battery is connected to the mid-point of the secondary winding. A condenser is connected across the two plates, in parallel with the secondary winding of the transformer, and the grids are supplied through another transformer with the negative of a grid battery connected to the mid-point of the secondary to give a fixed grid bias. The primary of the grid transformer is connected to a mechanical frequency generator, such as has been developed for operating radio receivers from a 6-volt battery. The generator is connected to the 24-volt filament battery, and sup-

plies about one watt of 60-cycle power. This a-c driving voltage is used to change the bias on the two grids alternately, so that first one tube will become conducting and then the other. As each tube in turn becomes conducting, a spurt of current flows through it from the plate battery, and this current flowing through the secondary of the plate transformer induces a voltage in the primary winding. Since these spurts of current to the two tubes flow in opposite directions through the secondary windings, an alternating voltage is induced in the primary, and the frequency of this voltage, which is controlled by the exciter voltage, is 60 cycles per second.

Thyratrons are gas tubes with a critical negative grid voltage at which they become conducting. Once current flow between plate and filament has begun, the grid loses control, and the tubes will remain conducting until the plate current is interrupted. The grid battery furnishes sufficient negative bias to make the tubes become conducting only at some point on the positive half-cycle of the exciting wave. The bridging condenser C serves to interrupt the current through one tube as the other becomes conducting. Assume, for example, that V1 is conducting. The end of condenser C connected to V1 will be essentially at the negative potential of the battery because there is only the small drop through the tube between it and the filament. The end of C connected to V2, however, will be at approximately the positive potential of the battery because no current is flowing through the half of the secondary winding of the transformer between V2 and the battery. As a result, C will be charged to practically the battery voltage with the positive end connected to V2. When V2 becomes conducting at the next half-cycle of the exciting source, the two terminals of the condenser will be connected together through the low impedance of the two tubes in series. As a result the condenser will discharge, and drive the plate of V1 negative with respect to its cathode. The conduction of V1 will thus stop, and the load current will pass through V2, giving the other half-cycle in the primary winding. The condenser will then be charged in the opposite direction, and will be ready to stop the conduction of V2 at the end of this half-cycle.

The condenser also serves as a means of adjusting the output a-c voltage in the primary of the plate transformer. This voltage is propor-

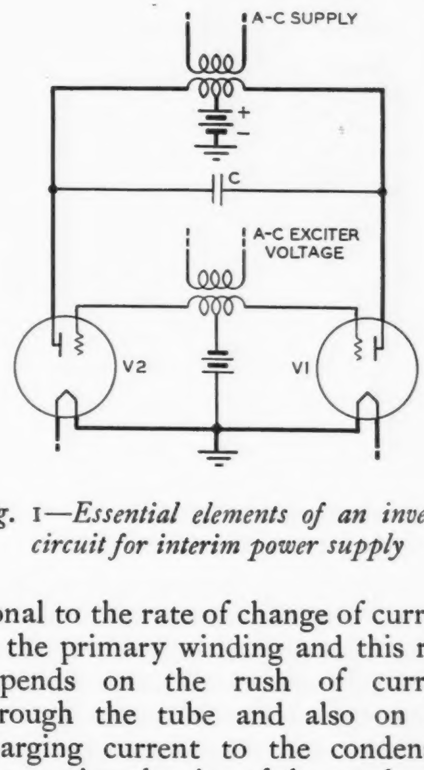


Fig. 1—Essential elements of an inverter circuit for interim power supply

tional to the rate of change of current in the primary winding and this rate depends on the rush of current through the tube and also on the charging current to the condenser. By varying the size of the condenser, the output voltage can be changed.

Commercial power lines now-a-days are very dependable. Outages are

comparatively rare. The use of the inverter will thus be small, and its cost should be kept low or the expense of the protection provided would be higher than could be economically justified. It was felt desirable, therefore, to make the inverter equipment serve a double purpose. The battery used as a source of power for the inverter will also serve various other purposes in the central office, and it must be kept charged.

It will be noticed that the circuit shown in Figure 1 is essentially like that of a full-wave rectifier; the differences being that for a rectifier, the negative terminal of the battery would be connected to the midpoint of the transformer, there would be no a-c excitation, and provision would have to be made for adjusting the grid bias in accordance with the battery voltage. It seemed entirely feasible, therefore, to use the inverter as a rectifier for charging the battery under normal conditions, and to provide a transfer relay that would change the connections to those required for inverter action on failure of the a-c power.

An inverter-rectifier of this type developed for the L carrier system is shown in simplified schematic form in Figure 2. A trial installation of one of these inverter-rectifiers at the Long Lines building in New York City is shown in the lower part of the photograph at the head of this article. T1 in Figure 2 is the plate transformer and T3, the grid-exciting transformer. The master control circuit changes the circuit from rectifier to inverter action when the a-c voltage drops to 90 per cent of its normal value. Besides the circuits that control the transfer on low voltage, the master control also includes a number of interlocking circuits to insure the proper sequence of actions under all conditions. The change of connections is made by operating relays TR and GR, the former disconnecting the a-c supply leads and reversing the connections of the plate battery and the latter connecting the a-c grid excitation with its fixed-negative battery. The bridging condenser c of Figure 1 is supplemented by an

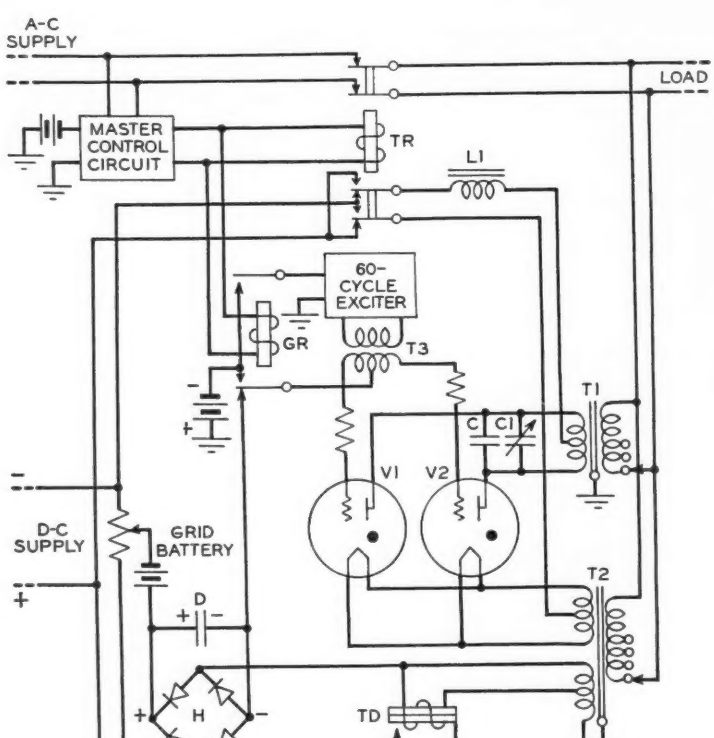


Fig. 2—Simplified schematic of the inverter-rectifier developed for the L carrier system

adjustable condenser C1 in parallel with it to provide control of the a-c output voltage. The varistor rectifier H, with the condenser D, is used to control the grid bias when the circuit is used as a rectifier. The control of the output of the circuit under rectifier operation is by the magnitude method as already described in the September, 1938, issue of the RECORD.

Transformer T2 supplies the voltages for the regulating circuit and the filament current under both rectifier and inverter operation. Relay TD, effective only after the circuit has been shut down, prevents application of high voltage to the tubes until the filaments have had time to reach approximately their normal heated temperatures. The coil L1 acts as a filter in the battery circuit under both conditions of operation. A view of the inverter with cover removed to show the arrangement of the apparatus is given in Figure 3.

The primary of the plate transformer is provided with taps, and the ratio of the transformer is made such that by use of these taps the rectifier will charge either a 132 or 142-volt battery at any a-c line potential from 210 to 250 volts. Connections to the taps are made to give a proper transformer ratio for charging.

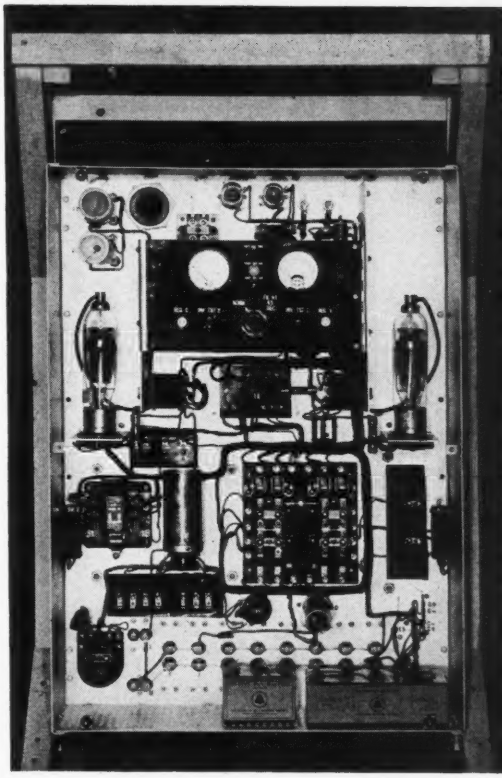
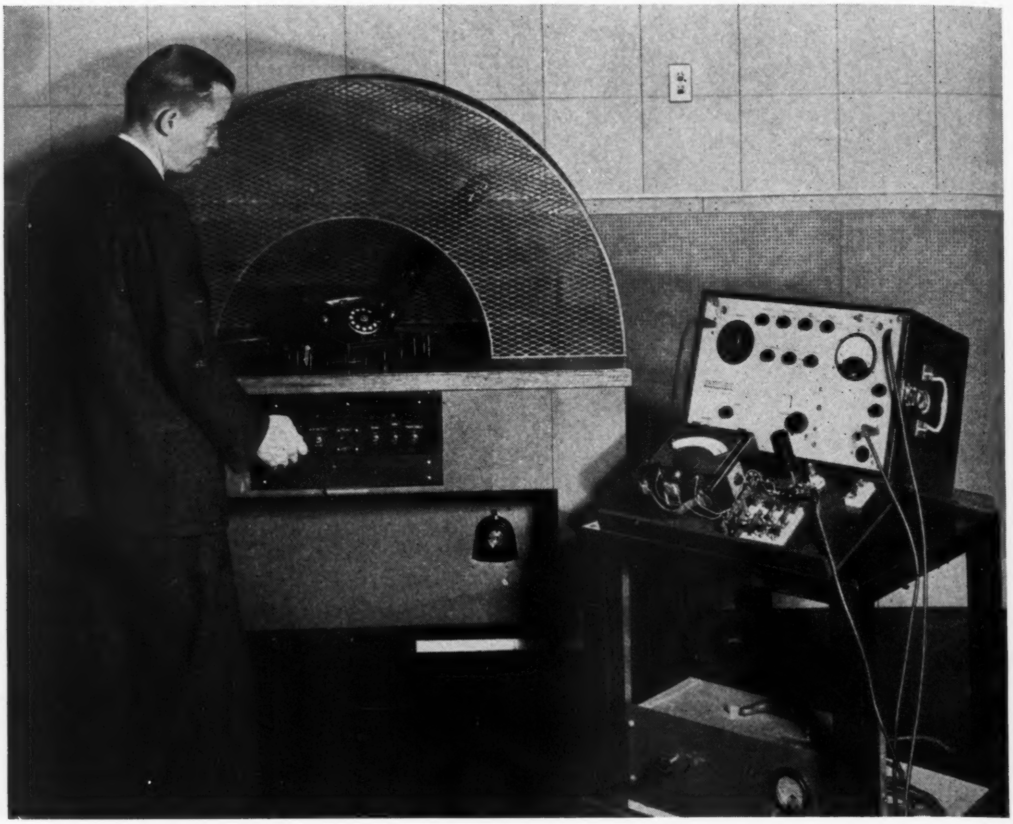


Fig. 3—An inverter-rectifier with its cover removed and mounted in its shipping crate



Sound-Integrating Machine

EXPLORING the sound field around a small source such as a ringer or loud speaker is usually a laborious and time-consuming task because it involves making many measurements in all directions around the radiating source. This effort is now avoided by doing the work automatically with a sound-integrating machine. The apparatus to be tested is rotated on a turntable while a small condenser microphone, which is mounted on the end of an arm, is swept back and forth over it. This arm is oscillated in a vertical plane through an angle of 180 degrees by a cam which moves it progressively more slowly as it approaches the ends of its excursion so that equal radiating areas are traversed in equal times. The output of the microphone is amplified and applied to an analyzer to determine the sound intensity in different frequency bands. A meter reading gives the average intensity of the sound in a selected band; and multiplication by a factor, involving the area of a hemisphere whose radius is the length of the microphone arm, gives the total power radiated in that particular band.

This integrator measures sound outputs in about one-fiftieth of the time previously required to make separate observations at many points about the source. It has been used extensively in developing ringers and telephone-set housings.

NEWS AND PICTURES OF THE MONTH

Testing a field trial installation of program-transmission equipment on the type-K carrier system between New York and Boston. The two bays shown mount the apparatus required at the New York terminal

News of the Month

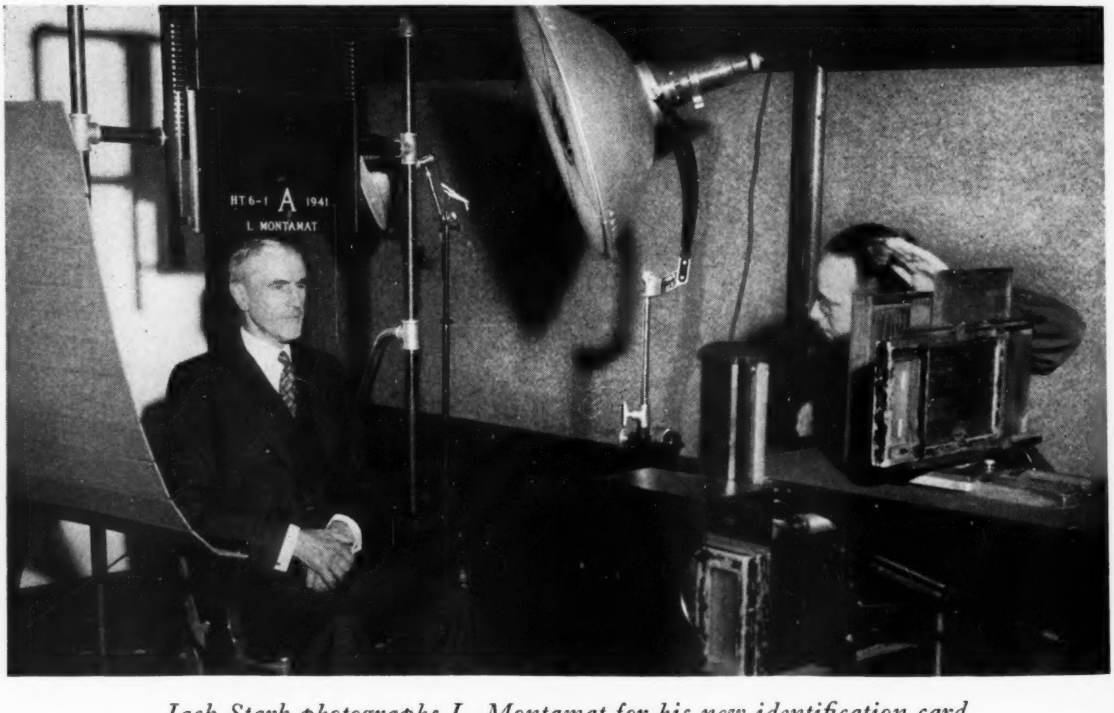
Laboratories Personnel Is Fingerprinted

Bell Telephone Laboratories, in common with U. S. government departments and industrial organizations engaged on problems of defense, has been asked by the Government to make fingerprints of all its employees. At the same time it was decided to take pass photographs for new identification cards. Initial plans and the layout of equipment for doing this work were arranged by M. L. Wilson, D. R. McCormick and D. D. Haggerty.

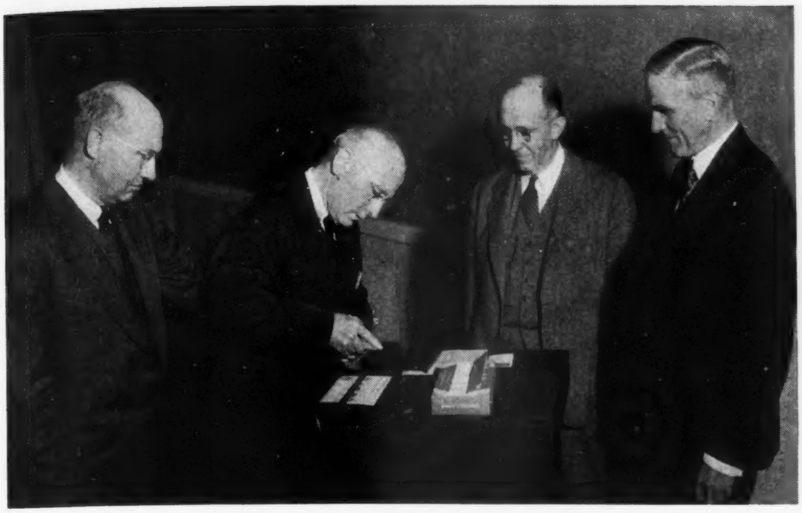
All fingerprinting and photographing is being done by members of the Laboratories under the general supervision of Mr. Haggerty, acting for the Personnel Department, in the auditorium at West Street. Miss C. W. Ackerman acts as receptionist and interviewer and enters the written identification data on the fingerprinting card. Identification photographs are taken by Jack Stark with J. E. Nelson and R. E. Dryden setting up the name, date and type of pass on a board which is placed on a rack over the individual's head and photographed at the same time as the individual.

For the fingerprints the major departments of the Laboratories are coöperating by furnishing nine men to do this work. These are J. G. Knapp, J. M. Finch and G. A. Head of the Research Department, W. W. Andrews, H. D. Bone and H. J. Ellwood of the Apparatus Development Department and W. A. Bollinger, W. A. Drake and F. W. Garland of the Systems Development Department. These same persons will take care of personnel at the Graybar and Davis buildings and at Whippany, Deal and Holmdel.

Operations were started on June 4 and it is expected that the Laboratories' personnel of approximately 4800 will have been covered by the end of July.



Jack Stark photographs L. Montamat for his new identification card



O. E. Buckley is fingerprinted by J. M. Finch as G. B. Thomas and L. Montamat wait their turns

During the Christmas season thirty-nine circuits were turned over, and on two occasions in May when working pairs of paper-insulated wires in the same sheath were damaged by lightning, the circuits were made good through the coaxial cable.

It is interesting to note that the circuit on which Mr. Gifford commented favorably employed voice frequencies from New York to Chicago, type-K carrier to Milwaukee, voice to Stevens Point, coaxial to Minneapolis, and voice to Chicago.

Stevens Point-Minneapolis Coaxial Cable

Regular commercial service over the new coaxial cable from Stevens Point to Minneapolis was established on June 9, when a circuit was set up from Minneapolis to New York. No public ceremonies were held, but a circuit from Minneapolis to Chicago was added, and conversation was held between President Gifford in New York and G. G. Jones, General Plant Superintendent of the Long Lines Department at Chicago. Mr. Gifford commented on the quietness and good quality of the circuit, which he said he had learned to expect from the new carrier telephone systems.

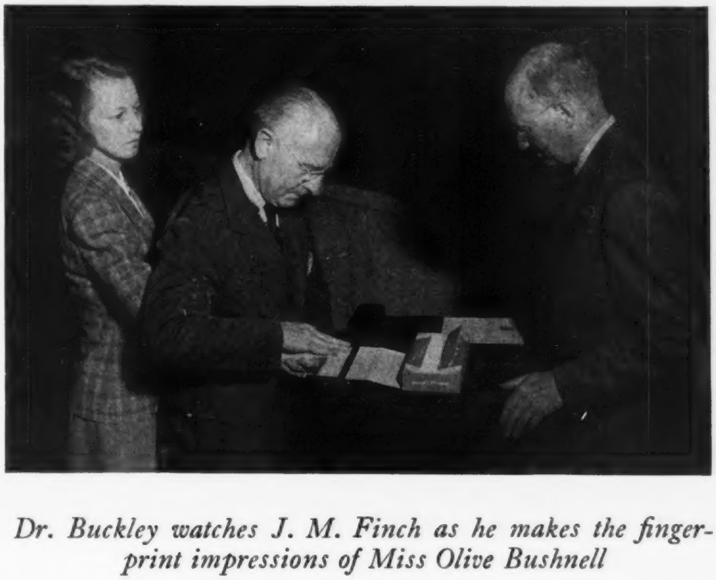
Currently seventeen circuits are working through the coaxial, and thirty-one more are available at any time. By additions, to terminal equipment, the cable will carry a total of 480 circuits.

This is not, however, the first time that these coaxials have carried commercial messages. A severe storm last November did heavy damage to wire plant, and the Laboratories' engineers made a number of circuits available to the local telephone people.

C.S.S. Pays Tribute to President Gifford

At the end of May, Walter S. Gifford completed ten years as president of the Community Service Society of New York. Noting that fact, the Society's *Bulletin* says:

"The Mr. Gifford *we* know as Chairman of the Board of the Society, is a man characterized by his simplicity and his great ability to relate his knowledge gained in other fields to our field of social work. . . .



Dr. Buckley watches J. M. Finch as he makes the fingerprint impressions of Miss Olive Bushnell

"Perhaps what impresses one most is Mr. Gifford's ability to get at the nub of a problem with insight and clarity, when the subject matter is so foreign to his daily work. His quick readiness to revise his opinions if new evidence presents itself is another aspect of his directness and his stature as a person. . . . "

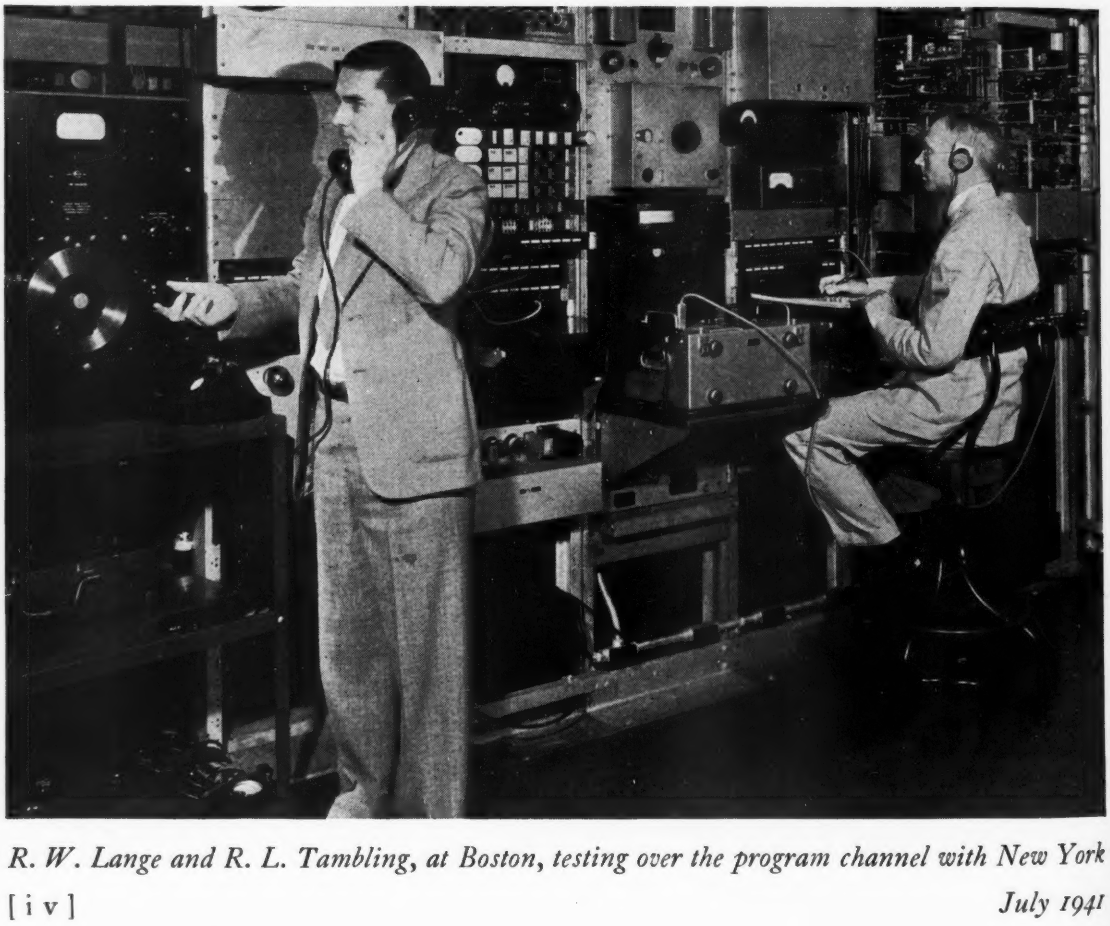
Program Transmission Over Type-K Carrier

A field trial of program transmission on type-K carrier systems is now being conducted between New York and Boston. This program system transmits a band of frequencies from 40 cycles to 8,000 cycles equalized for both attenuation and delay distortion. To accomplish this a special program terminal is furnished at each end of the carrier system which is cabled to the regular carrier terminal. Channels 6, 7 and 8 are removed from message service to provide frequency space for the program channel, the remaining nine channels being used for message business in the normal manner.

The program is modulated to a single-sideband position from 80 to 88 kilocycles which is then inserted in a 60 to 108-kilocycle channel group from which channels 6, 7 and 8 have been removed. The complete group consisting of one program channel and nine message channels is then modulated by the standard K group-modulating circuit to lie between 12 and 60 kilocycles for transmission over the cable pair. The program band is thus located from 32 to 40 kilocycles.

At the receiving end of the system this band of frequencies is amplified, demodulated along with the nine-message channels, filtered, and finally demodulated to the original program frequencies. The direction of transmission over the carrier link is reversible, a control tone of 78 kilocycles (42-kc line frequency) being used to set up the proper circuit conditions.

The principal objective of the field trial is the determination of the quality of transmission over the program channel itself and of the limitations imposed by mutual interference between this channel and the mes-



R. W. Lange and R. L. Tambling, at Boston, testing over the program channel with New York

sage channels transmitted over the same K system. Toward the latter part of the field trial special equipment will be added to the program terminal circuits so that tests may be made on program branching points involving K carrier systems.

The engineers carrying out the trial are H. A. ETHERIDGE, JR., shown in the photograph on page i, C. W. SCHRAMM and J. MAURUSHAT, JR., at the New York terminal at 32 Sixth Avenue and R. W. LANGE and R. L. TAMBLING at the Boston terminal.

J. Maurushat, Jr., at New York, making overall transmission measurements on program circuit

COLLOQUIUM

A. M. SKELLETT spoke on *The Magnetic-Focus Radial-Beam Vacuum Tube and Its Applications* at the May 19 meeting of the Colloquium, the last of the current season. A new type of vacuum tube was described in which a flat radial beam of electrons in a cylindrical structure may be made to rotate about the axis of the structure. Features of the tube are its absence of an internal focussing structure and resultant simplicity of design, its small size, and its high beam currents, measured in milliamperes, that are obtained with low voltages. The focussing of the beams and their directional control are accomplished by the magnetic fields produced by small polyphase motor stators.

Officers for next year are L. H. GERMER, president; H. E. IVES, vice president; and R. O. GRISDALE, secretary.

WHO'S WHO

THE 1941 EDITION of *Who's Who in Engineering* gives biographical listings for 225 members of the Laboratories. This is an increase of more than ten per cent over the listing in the 1937 edition. The representation of the Laboratories would, however, have been larger if all those who were qualified for entry had returned their questionnaires. The 1940-41 edition of *Who's Who in America* lists 19 members of the Laboratories and the sixth and last edition of *American Men of Science*, a total of 159.

COLLEGIATE DEGREES

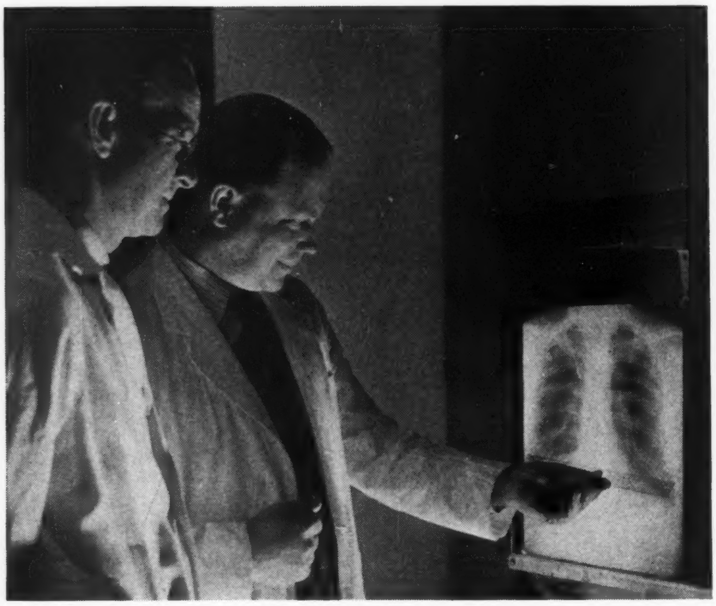
MEMBERS OF THE LABORATORIES to whom collegiate degrees have been awarded recently are:

C. A. Dahlbom	B.E.E.	Brooklyn Poly.
J. J. DeBuske	B.S. in E.E.	Newark Col. of Eng.
R. J. Kircher	M.Sc.	Stevens Inst.
W. F. Miller	B.S. in E.E.	Newark Col. of Eng.
C. V. Obst	M.E.	Brooklyn Poly.
T. L. Tanner	B.E.E.	N. Y. U.
C. W. Tucker	B.S. in Ch.E.	Cooper Union
F. E. Tucker	B.A.	N. Y. U.
B. T. Weber	M.A.	Columbia

X-RAY EXAMINATIONS

NEARLY A THOUSAND examinations are made each year with the modern X-ray equipment of our Medical Department. Suspicion of tuberculosis is the occasion for many of the major examinations, since an X-ray examination is the only method by which a diagnosis of a large majority of early tuberculosis cases can be made. The X-ray is also invaluable in making a diagnosis of certain complications of injuries, such as fractures and dislocations.

X-ray examinations are originated in the Medical Department or at the request of the employee's personal physician. In the latter case a written request must be presented in



Dr. Manson and Dr. O'Malley appraising a film of the heart and lungs

order that there may be no misunderstanding as to the nature of the examination. Forms for the purpose may be obtained from the Medical Department.

* * * * *

F. B. JEWETT is a director of the recently organized National Science Fund, sponsored by the National Academy of Sciences to receive and administer gifts for the support of fundamental scientific research.

AT THE ANNUAL MEETING of the National Academy of Sciences, O. E. BUCKLEY was elected Chairman of the Section of Engineering for a term of three years, succeeding Dr. Vannevar Bush.

DR. BUCKLEY, representing the field of communications, has been appointed a member of the Scientific Advisory Council of the Pan-American Trade Committee.

MEMBERS OF THE LABORATORIES who have been granted leaves of absence for military or naval service since the last issue of the RECORD are:

MICHAEL COLLINS, Headquarters Company, 56th Signal Battalion, Fort Jackson, Columbia, South Carolina.

STEPHEN DUMA, U.S.N.R. Aviation Base, Floyd Bennett Field, Brooklyn.

C. J. KUHN, Company C, 42nd Engineers, Camp Shelby, Mississippi.

A. J. LEIMER, Destroyer Unit, Naval Training Station, Norfolk, Virginia.

C. E. MERKEL, Division Headquarters Company, 4th Armored Division, Pine Camp, New York.

L. W. STAMMERJOHN, Engineers Corps, attached to 1st Aircraft Warning Company, Fort Monmouth, New Jersey.

K. O. THORP, Field Artillery Reserve, attached to Central Air Corps Procurement District, Detroit, Michigan. (Address: 8505 West Warren Avenue, Detroit.)

THE FRONTISPIECE of this issue is an artist's conception of a research laboratory, drawn as an illustration for an advertisement for the New York Telephone Com-

Miss Adams making X-ray film of the abdomen

pany. Captioned *Here's Why Americans Have "The Best Telephone Service in the World,"* the advertisement points out the value of technical developments in providing communication service both for civilian and defense requirements.

Two photographs taken in the Laboratories furnished the basis for the drawing. In the foreground is a dispersion comparator for measuring the optical constants of metals; a setup for depositing thin films of metal in vacua is shown in the background.

"For his technical contributions to modern efficiency of long-distance telephony, particularly his development of the feedback amplifier" is the citation that accompanies The Franklin Institute's recent award of the John Price Wetherell Medal to Harold S. Black

THE 1941 ROSTER of committee memberships in the Institute of Radio Engineers reflects the extensive work of the Laboratories in the radio field. The *Board of Directors* of the Institute includes H. T. FRIIS, R. A. HEISING and F. B. LLEWELLYN; and on the *Board of Editors* are F. B. LLEWELLYN, E. L. NELSON, L. J. SIVIAN and WILLIAM WILSON. Committee memberships included *Admission*, F. W. CUNNINGHAM and H. T. FRIIS; *Awards*, RALPH BOWN; *Constitution and Laws*, R. A. HEISING; *Membership*, F. W. CUNNINGHAM, and F. B. LLEWELLYN; *New York Program*, W. M. GOODALL.

Nominations, RALPH BOWN; *Papers*, WILLIAM WILSON, chairman, H. A. AFFEL, EDMOND BRUCE, E. B. FERRELL, H. T. FRIIS, D. K. MARTIN, R. K. POTTER and R. L. DIETZOLD; *Regular Papers*, A. A. OSWALD; *Preparedness*, R. A. HEISING; *Public Relations*, G. W. GILMAN; *Sections*, R. A. HEISING, chairman, and F. A. POLKINGHORN; *Tellers*, W. M. GOODALL; *Electroacoustics*, G. G. MULLER and L. J. SIVIAN; *Electronics*, S. B. INGRAM, F. B. LLEWELLYN and J. R. WILSON; *Frequency Modulation*, G. W. GILMAN; *Piezoelectric Crystals*, W. L. BOND and W. P. MASON; *Radio Receivers*, H. B. FISCHER; *Standards*, RALPH BOWN; *Symbols*, C. R. BURROWS, F. B. LLEWELLYN and L. J. SIVIAN; *Television*, A. G. JENSEN; *Transmitters and Antennas*, J. F. MORRISON and J. C. SCHELLENG; and *Wave Propagation*, C. R. BURROWS.

Institute representatives on other bodies include WILLIAM WILSON, American Documentation Institute; LLOYD ESPENSCHIED, National Advisory Council on Radio in Education, Committee on Engineering Developments; and E. L. NELSON, Planning Committee, National Conference on Educational Broadcasting, American Council on Education.

W. SHOCKLEY participated in a symposium on *Hardening of Metals* held at the University of Pennsylvania on May 16 and 17. This symposium was sponsored jointly by the University's Department of Physics and the Philadelphia chapter of the American Society for Metals. I. V. WILLIAMS also attended this symposium.

R. R. WILLIAMS has been listed by the University of Chicago as among those to receive honorary degrees in the sciences and humanities at the celebration of the University's fiftieth anniversary next fall.

S. O. MORGAN attended the meeting of the Sub-Committee for Physics of the Na-

tional Research Council Conference on Electrical Insulation, held in Washington.

B. L. CLARKE was reëlected a member of the Board of Directors, New York Section of the American Chemical Society, for the 1941-42 year.

R. M. BURNS gave a talk on *Protection of Metals* before the Hartford Chapter of the American Society for Metals.

* * * * *

J. H. BELL, Telegraph Engineer of the Switching Development Department, retired from active service on June 30. Mr. Bell joined the Bell System on July 1, 1911, and since then has been continuously concerned with the development of telegraph systems. Starting with the metallic telegraph system, his work successively covered several open-wire d-c systems, voice-frequency and high-frequency systems and the more recent nation-wide teletypewriter system. In addition to being intimately associated with the development of these systems he was responsible for much of the testing equipment required for their maintenance. The development of telephotography also came under his supervision.

J. H. Bell

Early in 1914 Mr. Bell went to England to study the possible field for Western Electric multiplex telegraph systems and later in the year installed such a system between London and Manchester. Within six weeks after installation this system was carrying 4,000 messages daily. Six years later he made another trip through the Western European countries to investigate the possible use of multiplex equipment in these countries. Before joining the Bell System, Mr. Bell, who was born in Aberdeen, Scotland, spent over eleven years in the communication field. He was in South Africa for over two years with the Signal Corps of the British Army during the Boer War and then, in 1902, went with the Engineering Department of the British Post Office on the development, installation and maintenance of telegraph apparatus and systems.

THREE OTHER MEMBERS of the Laboratories who retired on June 30 were Thomas Creaven, Antonio Frigugli-etto and Rocco Stoppelli of the Building Service Department, all on the 65-year Retirement Rule. Tom Creaven, who completed thirty-five years of service this past April, worked for a time as a porter when the manufacture

Rocco Stoppelli

Antonio Friguglietto

Thomas Creaven

Harry Kohler, in the Development Shop, filing a hard-rubber detail for a tape-welding machine

of telephone apparatus was carried on by the Western Electric Company at West Street and then became an elevator operator. For the past twenty years he has been a uniformed watchman and elevator operator, in which capacity he has filled a variety of assignments.

"Tony," as Mr. Friguglietto is known throughout the building, started with the Western Electric Company over thirty-one years ago as a cleaner, working in the Machine Shop and then in the Buffing Department. Later, he was transferred to porter service and for the past sixteen years has been assigned to the ninth and tenth floors of the building. His pleasant smile and courteous manner will long be remembered, particularly by those who received his shoe-shining service.

Rocco Stoppelli joined the Engineering Department of the Western Electric Company as a night cleaner in 1923 and then advanced to night watchman, working from 4 P.M. to midnight. He was rather older than the other watchmen and had a quiet and unassuming disposition; he has always been held in high regard by his associates in the Laboratories.

C. J. Frosch visited the Tennessee Eastman Company at Kingsport, Tennessee, in connection with the molding of plastics. He also was in Hawthorne where he discussed problems associated with the manufacture of plastic telephone sets.

A. C. Walker has been reëlected a director of the United States Institute for Textile Research. He is also a member of the Research Council of the Institute.

C. W. Tucker, Jr., of the Chemical Laboratories, who has recently finished a

W. E. Peery measuring the characteristics of a "slug" adjusted inductance

six-year chemical engineering course at Cooper Union, has been awarded the William L. Heim research fellowship for study in the field of X-ray technology at Lehigh University. During the past year he was also elected to Mu Alpha Omicron, honor society of Cooper Union.

An article, *Industrial Mathematics*, by T. C. Fry was published in the June issue of *The Technology Review* of M.I.T.

An article, *Operation of Electrostatic Photo-Multipliers*, by R. C. Winans and J. R. Pierce was published in the May issue of *The Review of Scientific Instruments.*

G. E. Moore and H. W. Allison were the authors of an article entitled *Spectral and*

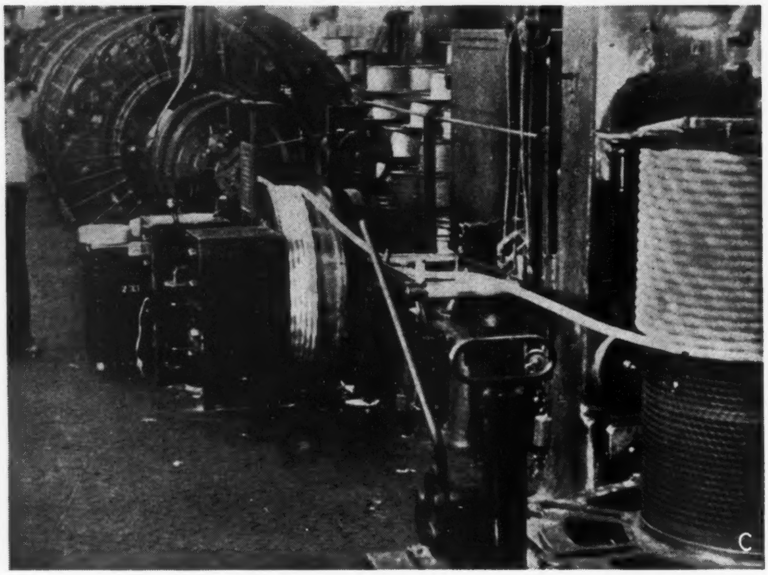
Total Emissivities of Oxide-Coated Cathodes published in the May issue of the *Journal of Applied Physics.*

H. E. IVES spoke on *A Physicist Looks at Painting* at a meeting of the Rochester section of the Optical Society of America.

R. BOWN and G. W. GILMAN visited Norfolk and Tangier Island, Virginia, and Crisfield, Maryland, to observe the installation and operation of several newly designed radio telephone systems in these regions.

C. N. ANDERSON is spending a few weeks in the areas served by the New Orleans and Galveston coastal-harbor radio telephone systems, making engineering observations of this service with boats along the Gulf coast and inland waterways of the vicinity.

A GROUP LUNCHEON of the supervisors of the Apparatus Development Department was held at the Hotel Abbey on May 27. Following the luncheon, O. A. SHANN, presiding at the meeting, introduced the



A—Assembly of coaxial amplifier hut for the cable between Stevens Point and Minneapolis

B—Plowing in coaxial cable—Stevens Point to Minneapolis

C—Coaxial cable-twisting machine at Western Electric Point Breeze Plant

During the week of May 12 nearly 2000 members of the Laboratories viewed, during noon periods, the motion picture entitled COAXIAL, *recently released by the American Telephone and Telegraph Company. The film covered the manufacture and installation of the 200-mile coaxial cable between Stevens Point and Minneapolis*

speaker, R. L. JONES, Director of Apparatus Development. Mr. Jones spoke on the subject *The Laboratories and Defense.* The committee in charge of arrangements consisted of W. A. BOYD, P. S. DARNELL, J. B. DIXON, E. C. EDWARDS, W. H. EDWARDS, O. M. HOVGAARD, W. H. SELLEW, O. A. SHANN and J. M. WILSON.

AT THE POINT BREEZE plant of the Western Electric Company, H. H. GLENN discussed the development of station cords and H. H. STAEBNER, the preparation of special station cords for trial in New Orleans.

E. B. WOOD and O. C. ELIASON visited Springfield, Massachusetts, on May 21 where they discussed, with engineers of the New England Telephone and Telegraph Company, a unit-ventilator installation for a central-office building.

N. C. Olmstead of Whippany Laboratory and F. M. Ballou of the I.T.E. Company discuss a circuit-breaker problem

J. C. VOGEL and J. W. KITTNER investigated manufacturing variations on 20-type test sets at the Specialty Products Shop of the Western Electric Company at Kearny.

D. D. MILLER visited a number of unattended dial offices in Kentucky.

DURING THE MONTHS of May and June the following members of the Laboratories completed twenty years of service:

Research Department

H. W. Dudley	W. P. Mason

Apparatus Development Department

A. G. Dalton	R. O. Hagenbuck
F. F. Farnsworth	C. E. Lane
S. J. Harazim	Miss I. Wiberg

Systems Development Department

O. H. Coolidge	R. L. Pentland
M. C. Goddard	J. C. Rile
E. I. Green	E. M. Smith
F. K. Low	I. G. Wilson
C. H. McCandless	L. A. Yost
J. Zoller	

Patent	*Personnel*
H. O. Wright	R. A. Deller

General Service	*Plant Shops*
Mrs. Eleanor Iasillo	Prescott May

AT THE HAWTHORNE PLANT of the Western Electric Company, J. E. RANGES discussed the development of new exchange-area loading-coil cases; J. R. TOWNSEND, substitutions for strategic materials; T. S. HUXHAM, molding problems; D. G. BLATTNER, the development of dials, message registers and other telephone apparatus; L. S. FORD, coded cable and other cable engineering problems; and T. C. CAMPBELL, rolling ladders.

J. E. SHAFER attended the Quality Survey on polarized relays held at Kearny.

TWENTY-FIVE-YEAR SERVICE ANNIVERSARIES

HARVEY FLETCHER entered the Laboratories in 1916, with the degree of Ph.D. from Chicago, and immediately attacked problems of speech and hearing in relation to electrical communication. This work laid the broad foundation which was necessary for the high-quality transmission systems that are used today in telephony, radio and sound pictures.

To this field Dr. Fletcher's contributions have been important. Perceiving the need for improved means of hearing-measurement, he directed the development of the Western Electric audiometer, a scientific device now in general use in otology. With

Harvey Fletcher

E. C. Wente

E. D. Mead

this instrument, he measured the hearing of hundreds of people, and determined the thresholds of hearing for normal ears. An outgrowth of these tests was the phonograph audiometer for the group testing of schoolchildren's hearing. Through coöperative investigations with otologists and physiologists he has aided in the establishment of several research centers among universities and institutes which are now devoted entirely to fundamental studies of hearing.

Through Dr. Fletcher's studies of binaural hearing, the idea occurred to him that the sense of space might be conveyed adequately to an audience if there were three complete sound channels between them and the originating stage. Such a system was set up under his direction between Philadelphia and Washington in 1933, and successfully demonstrated. A similar system, involving extra-wide range sound records and enhancement of the loudness range, was demonstrated last year in New York.

Through leadership as well Dr. Fletcher has contributed; in 1928 he became Acoustical Research Director and in 1934 Physical Research Director with responsibility added for work in magnetics, electronics, metals and carbon. Among professional society offices which he has held are the presidencies of the Acoustical Society and the Federation of Organizations for the Hard of Hearing; he has sat on boards of directors of other societies. He is a member of the National Academy of Sciences and an honorary member of the Otological Society. His published papers are numerous, and he is author of the book "Speech and Hearing."

To his community, Dr. Fletcher has given many years of leadership in church work. Of his six children, one is an attorney in the Bell System and one a research physicist for the Navy.

* * * * *

SYMBOLIZING twenty-five years in the Laboratories, a five-star service emblem has been presented to EDWARD C. WENTE. Two years after he entered the Research group, he left for graduate study at Yale, where he received his Ph.D. in 1918. In the Laboratories, he has always worked on acoustical problems. First of these was the development of a faithful microphone, stable enough in sensitivity that it could be used for measurement. For that, he was later awarded the John Price Wetherell Medal by The Franklin Institute. A second development was the ribbon light valve as a means of recording sounds on motion picture film so that they could be studied at leisure. These elements, combined with a loud speaker also of his design, and with suitable amplifiers, are basic to the huge sound picture industry of today. A later microphone, having a light diaphragm and moving coil, is now widely used in sound pictures, radio and speech reinforcement. For these contributions to the art, Dr. Wente received the first

Progress Medal of the Society of Motion Picture Engineers in 1935.

For several years, he has headed a group engaged in research on speech, hearing and other acoustical subjects. Among the projects of that group have been the stereophonic transmission of sound from Philadelphia to Washington in 1933, and the stereophonic recording and reproduction of sound in 1940.

Dr. Wente is president this year of the Acoustical Society and a member of its Editorial Board; a member of the S.M.P.E., the Physical Society and the Telephone Pioneers of America. With their two boys, aged ten and four, the Wentes live in Manhattan, where they enjoy the opportunities it offers to music-lovers.

* * * * *

TESTING TELEPHONE CABLES and loading coils and building testing equipment were E. D. MEAD's introduction to the communication industry during two short periods with the Western Electric Engineering Department in 1909 and 1911. He then completed his formal education at Lafayette from which he received a B.S. degree in 1914. He rejoined the Engineering Department in 1917 and from then until 1936 was engaged principally in the development of various electromagnetic apparatus, such as relays, including high-speed relays, electromagnets for switching mechanisms, telephone registers, timing equipments, mounting plates and resistances.

Since 1936, in what is now the Switching Apparatus Development Department, Mr. Mead has been associated with the development of crossbar apparatus, particularly the 1- and 2-type timers for registering calls. He has also been in charge of the development of multi-contact relays, terminal strips, crossbar switches and various tools required for the maintenance of crossbar apparatus. His fourteen applications for patents testify to his contributions to the art.

* * * * *

MOST OF L. C. WESCOAT's twenty-five years of service in the Bell System has been devoted to the development of power apparatus and systems for central offices and for sound picture equipment. Following his graduation by Pennsylvania State College in 1910 with a B.S. in E.E. degree he was with the General Electric Company for six years, first in Schenectady and then in New York City, on power switchboard engineering. His first work at West Street was on power equipment for the semi-mechanical system then being installed at Newark. During the war period he was also associated

E. W. NILES
of the Station Apparatus Development Department completed thirty-five years of service on June 4

L. P. FERRIS
of the Transmission Engineering Department completed thirty years of Bell System service on June 7

F. H. BEST
of the Transmission Engineering Department completed thirty years of Bell System service on June 26

A. H. Schirmer
of the Transmission Engineering Department completed thirty years of Bell System service on June 26

R. T. Staples
of the Transmission Apparatus Development Department completed thirty-five years of service on June 10

O. S. Markuson
of the Outside Plant Development Department completed thirty years of Bell System service on June 12

with the design of power equipment for Signal Corps purposes. Later he was associated with the development of power plants for the first panel systems, particularly the emergency control equipment for unit-drive motors and the development of duplex-drive motors for later panel systems.

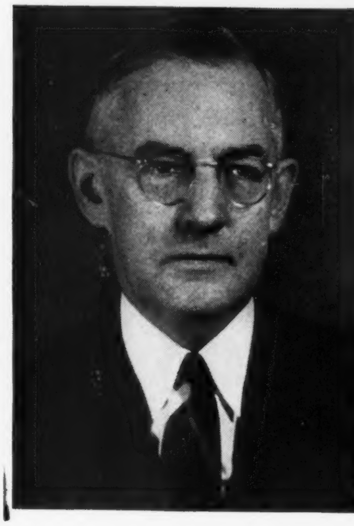
From 1929 to 1936 Mr. Wescoat was with Electrical Research Products on power engineering work and then on the development of equipment for sound-reproducing systems for theaters. Since his return to the Laboratories in 1936 he has been in the test and analysis group of the Power Development Department where his work has been mainly on motors and associated control equipment for telephone systems.

Since 1938 Mr. Wescoat has been a First Aid instructor and examiner in the course sponsored by the Personnel Department jointly with the American Red Cross; he also conducts courses in his home community of Packanack Lake, New Jersey. He is an officer of the Packanack Yacht Club, an active member of the Laboratories Sailing Club, a Telephone Pioneer, and a member of the Wayne Township district committee of the Boy Scouts of America. The Wescoats have one son who is now enlisted in the Air Corps and stationed at Mitchel Field.

After J. A. Coy received his E.E. degree from Syracuse University in 1915 he spent one year with the Westinghouse Electric and Manufacturing Company. He then joined the equipment section of the A. T. & T. Long Lines Department, where, in Buffalo and later in New York, he received twelve years of wide experience in the field. In 1928, Mr. Coy transferred to the Equipment Development Department of the Laboratories and since then has been associated with the development of equipment for toll telephone systems and is now in charge of a group handling equipment development problems on carrier systems and voice-frequency terminals for radio circuits. Among the more important projects on which he has made valuable contributions are pilot-wire regulators for four-wire repeaters; voice-frequency terminals for transoceanic radio circuits; the terminal equipment for the telephotograph system now being used on a nationwide basis by the Associated Press; equipment for open-wire carrier systems such as the type-C and type-J; and cable terminal equipment for the more recently developed coaxial cable system.

The Coys, who live in Glenridge, New Jersey, have a daughter who is a graduate of Bloomfield College.

Paul Neill joined the Apparatus Design group of the Western Electric Company in 1916. Before this he had spent twelve years with the Westinghouse Electric and Manufacturing Company where he was concerned with the development, testing and manufacturing of electrical instruments and watt-hour meters. In this connection he was among the first, if not the first, to apply the stroboscope to the testing of these meters. He also developed means for rapidly magnetizing magnets having very small air-gaps and was associated with the early electrification of the New Haven Railroad, particularly in matters pertaining to the use of indicating and recording instruments on the electric locomotives.



L. C. Wescoat

William Stumpf

Mr. Neill's first work with the Laboratories was on the design and development of keys. During the war period he worked on the design of airplane detectors, air-damped transmitters for submarine detection and gun ranging as well as telephone sets for location of enemy underground mining operations. More recently in the Switching Apparatus Development Department he has been engaged in the design and development of central-office apparatus specializing in plugs and jacks and gauges for their maintenance.

In his home community of East Orange, Mr. Neill is a member of the Glee Club of the Oranges and for the past three years has been its financial secretary. He is fond of woodworking, chess and fresh-water fishing and is a Telephone Pioneer. The Neills have two boys, one a Dartmouth graduate of 1935 now with the Insurance Company of North America, and the other, graduated by Washington & Lee in 1938, is in the College Department of Henry Holt and Company, publishers.

* * *

J. A. Coy

Paul Neill

Back in 1916 William Stumpf joined the Engineering Department of the Western Electric Company in the General Information Service group. He was placed in charge of the catalog files and the display of development, or "Y," models and samples of competitive apparatus. During this time he studied at Cooper Union from which he received a B.S. in E.E. degree in 1921. From 1922 to 1928 Mr. Stumpf was in the Commercial Relations

Department and then transferred to the Western Electric Company at 195 Broadway to prepare information and bulletins for the use of Western Electric distributors.

Late in 1928 he joined the Electrical Research Products. For most of the next ten years he was in charge of a department engaged in production planning, purchasing, and the field inspection of apparatus obtained from various suppliers for use in recording studios and theaters. He returned to the Commercial Relations Department of the Laboratories in 1938. Mr. Stumpf, who lives in Jackson Heights, is a Telephone Pioneer and active in several fraternal organizations. Included in his recreations are bowling, golf and tennis.

* * * * *

Before joining the Bell System V. F. Miller worked for Weston Electrical Instrument Company in Newark for four years on the design of various types of measuring instruments. In 1916 he joined the apparatus drafting group of the Western Electric Engineering Department and then, two years later, transferred to the machine-switching group of the Apparatus Development Department. Here he was successively associated with the design of apparatus for the panel, coördinate and crossbar central-office systems.

Mr. Miller lives in Queens and has two boys; one has just finished his second year at Cornell while the other, who had the highest rating in his school district, has been chosen for Townsend Harris High School in New York City. Mr. Miller's recreation is fishing in Peconic Bay and along the shores of Long Island.

* * * * *

On the seventeenth of June John Cummings received a five-star emblem signifying his completion of twenty-five years of service with the Western Electric Company and the Laboratories. During his service he has been a fireman in the power service group of the Plant Department. When he first came here all electric power and steam for the West Street building were generated in its own plant. After the generation of power was discontinued in 1923, he continued as a fireman as steam was still required for heating and auxiliary purposes.

* * * * *

G. H. Somerville joined the machine switching group of the Western Electric Company in 1916 as a draftsman and was concerned with the preparation of drawings for the semi-mechanical system being installed in Newark; and later for the Metropolitan Toll semi-mechanical office. In 1921 he transferred to the Systems Development Department where he made relay studies and two years later became a member of what is now the Switching Apparatus Development Department where he has since been associated with studies on the characteristics of relays made by Western Electric

V. F. Miller

John Cummings

G. H. Somerville

J. F. BALDWIN, JR.
of the Switching Apparatus Development Department completed thirty years of Bell System service on June 18

U. S. FORD
of the Equipment Development Department completed thirty-five years of service in the Bell System on June 22

L. C. MUELLER
of the Commercial Products Development Department completed thirty years of Bell System service on June 9

and those of outside manufacture used in telephone circuits. He is also responsible for the analysis of relay code requests and specifications for these relays prior to the issuance of manufacturing information.

Mr. Somerville studied electrical engineering at The College of the City of New York and at New York University, receiving a B.E.E. degree from the latter last February. He is secretary of Local Selective Service Draft Board No. 66 in Manhattan. The making of motion pictures is his principal recreation and his vacations are usually spent in Canada. He is a member of the Edward J. Hall Chapter, Telephone Pioneers of America and of the American Institute of Electrical Engineers.

L. E. BENNETT of the Western Electric Company at Hawthorne visited the Laboratories to discuss crossbar developments.

F. W. CLAYDEN and J. H. WADDELL visited several exchanges in Connecticut in connection with step-by-step problems.

J. R. TOWNSEND and W. ORVIS attended the annual meeting of the Society of the Plastics Industry, Inc., at Hot Springs, Va.

W. ORVIS and R. BURNS visited the Nixon Nitration Works at Nixon, New Jersey, and the Hercules Powder Company at Parlin, New Jersey, to discuss thermoplastic molding materials.

DURING MAY, N. S. EWING and R. MARINO were at the Patent Office in Washington on patent matters.

DURING THE MONTH OF MAY PATENTS WERE ISSUED TO THE FOLLOWING MEMBERS OF THE LABORATORIES

B. C. Bellows
A. F. Bennett
O. B. Blackwell
H. W. Bode
W. L. Bond (2)
J. W. Clark
H. W. Dudley (5)
L. L. Eagon
L. A. Gardner
K. E. Gould
J. B. Hays
R. A. Hecht
W. H. T. Holden
Francis A. Hubbard
J. A. Kater
G. V. King
R. J. Kircher
F. A. Korn
E. A. Krauth
W. V. K. Large
R. K. McAlpine
R. S. Ohl (2)
R. E. Polk
T. J. Pope (2)
W. T. Rea
F. F. Romanow
L. G. Schimpf
E. E. Schumacher
F. J. Singer
A. M. Skellett
A. G. Souden
W. L. Tuffnell
H. N. Wagar
E. F. Watson
H. W. Weinhart

L. N. Hampton, J. M. Melick and A. H. Shangle, at the plant of the Walter Kidde Company, Bloomfield, N. J., studied discharge rates of dry-gas fire extinguishers.

H. Winter checking vacuum tubes used in the transmission development laboratories

At Rochester, J. R. Fry attended a meeting of the American Institute of Electrical Engineers and O. M. Hovgaard, a meeting of the Acoustical Society of America.

R. H. Colley visited creosoting plants in the South to study the current production of creosoted southern-pine poles.

C. H. Amadon recently went to Boston and Portland (Maine) in connection with the ground-line treatment of poles, inspection of western-cedar poles and the investigation of northern-cedar poles in service.

G. Q. Lumsden, in Boston, demonstrated the ground-line treatment of poles in service.

D. T. Sharpe, T. C. Henneberger and J. G. Brearley investigated a break in the submarine section of the New York-Philadelphia coaxial cable under the Hackensack River in New Jersey.

M. T. Dow has gone to St. Charles, Missouri, to join W. E. Reid in making tests of crosstalk at type-K frequencies on the new St. Louis-Kansas City "B" cable.

O. S. Markuson and J. W. Kennard of the Outside Plant Development Department's group at Point Breeze were in New York City for discussion of toll-cable development problems.

R. P. Ashbaugh was in Denver, Colorado, for the "burial" of cable samples in connection with the study of protection of cables against attack by gophers.

T. A. McCann went to Dayton on May 12 to consult with U. S. Army Air Corps engineers about new uses of teletypewriters.

D. H. Wetherell, R. F. Massonneau, O. H. Williford and D. L. Moody, with engineers of the A. T. & T., discussed a-c key-pulsing equipment at Baltimore.

A steel detail being fabricated by Erland Johnson, a millwright in the Building Shop

B. H. Jackson was in Chicago representing the Laboratories in interference proceedings, while A. F. Kane appeared before the Primary Examiner at the Patent Office.

W. G. Schaer, G. H. Peterson and L. A. Yost, with engineers of the A. T. & T. and the New Jersey Bell Telephone Company,

inspected a No. 12-type central office at Eatontown, New Jersey.

W. W. Rindlaub, together with an A. T. & T. representative, inspected a fluorescent lighting system that has been installed in a central office at Baltimore.

R. C. Johnson inspected new types of distributing frames installed at Kanawha Falls, West Virginia, Macon, Ohio, and Fort Wayne, Ind.

A. C. Gilmore visited a No. 12 office at Cataumet, Massachusetts.

B. C. Bellows, Jr., and J. F. Polhemus visited Philadelphia in connection with the coaxial carrier telephone installation. Mr. Bellows also made several visits to Princeton on this same project.

A. J. Wier and C. A. Smith visited the type-K carrier auxiliary station north of Washington in regard to the "F" cable installation of VI telephone repeaters.

V. T. Callahan was at Toronto, Canada, and Lansing, Michigan, on emergency engine problems.

C. S. Knowlton visited the Raytheon Manufacturing Company at Waltham, Massachusetts, to discuss various types of rectifiers.

R. P. Jutson was at Eau Claire, Wisconsin, in connection with power problems associated with the Minneapolis-Stevens Point coaxial cable system.

F. T. Forster attended a battery conference held in Philadelphia.

H. T. Langabeer discussed automatic power plant questions with engineers of the Southwestern Bell Telephone Company at St. Louis, Missouri.

H. M. Spicer visited the Struthers-Dunn Company at Philadelphia on matters pertaining to power-relay problems.

J. H. Sole, at the Pioneer Gen-E-Motor Corporation and Eicor Corporation at Chicago and the General Electric Company at Fort Wayne, Indiana, discussed the design of power apparatus.

E. W. Hancock and W. I. McCullagh spent the month of May in Pittsburgh where the first crossbar office in that area is in the process of being tested.

J. M. Reilly, 1895-1941

G. A. Hurst spent most of May in Atlanta testing circuit modifications of panel-office equipment that serves to complete calls from step-by-step offices.

H. M. Pruden spent three days in Crisfield and Smith Island, Maryland, and Tangier Island, Virginia, in connection with the ultra-high-frequency radio installation which links these places.

C. R. Gray was at Syracuse, New York, to observe field conditions in step-by-step type central offices.

O. H. Williford made several visits to Baltimore where the first crossbar central office in that area is being installed.

D. W. Bodle is in Joplin, Missouri, making lightning investigations along the Kansas City-Joplin cables.

* * * * *

J. M. Reilly, with over twenty-nine years of service in the Bell System, died suddenly on June 17. Mr. Reilly joined the Manufacturing Department of the Western Electric Company in 1911 and engaged in assembling train-dispatching apparatus. Nine months later he transferred to the Model Shop where he remained until 1924, first as an apprentice and then as an instrument maker.

In 1924, Mr. Reilly transferred to the Building Service Department as foreman of one of the three shifts maintained to service the physical plant of the Laboratories. This work included the protection of the building at all times and all other building services. He was placed in charge of this department in 1928. When the restaurant and telephone exchange were added to this group in 1933 he became Building Operation Superintendent. For nine months starting May, 1935, he was temporarily placed in charge of the Building Shop. At the end of that period he returned to the plant operation group, adding to his former duties the responsibility for power service, with the title of Building and Power Service Superintendent.

D. E. Brenneman, at Eau Claire, Wisconsin, is making lightning investigations on the Stevens Point-Minneapolis coaxial cable.

L. P. Ferris and E. H. Gilson were also in Eau Claire on matters pertaining to the installation of oscillographs.

R. A. Shetzline, M. A. Logan and E. B. Mechling made crosstalk tests at Springfield, Massachusetts, in connection with proposed methods of dial-office wiring.

G. Wascheck aided the New England Telephone and Telegraph Company in making earth-resistivity measurements along the proposed cable route between Boston and Portland, Maine.

D. T. Osgood, J. F. Nuner, C. O. Cross and Miss O. S. Johnson in southern Maryland continued field studies on rural power distribution lines in coöperation with the Rural Electrification Administration.

L. Y. Lacy made noise and crosstalk tests on facilities proposed for special trunks from New York to the Murray Hill Laboratory.

L. K. Swart attended an aerial cable exchange protection conference with the New England Telephone and Telegraph Company in Boston.

A. J. Aikens tested noise and crosstalk on facilities for loops from broadcast studios to frequency-modulation transmitters.

A. G. Hall, at Point Breeze, discussed the development of protective coverings for lead-covered cables.

H. C. Franke was in Washington and Charlotte testing type-K carrier systems.

L. L. Glezen in Minneapolis and Stevens Point studied transmission stability of the coaxial system.

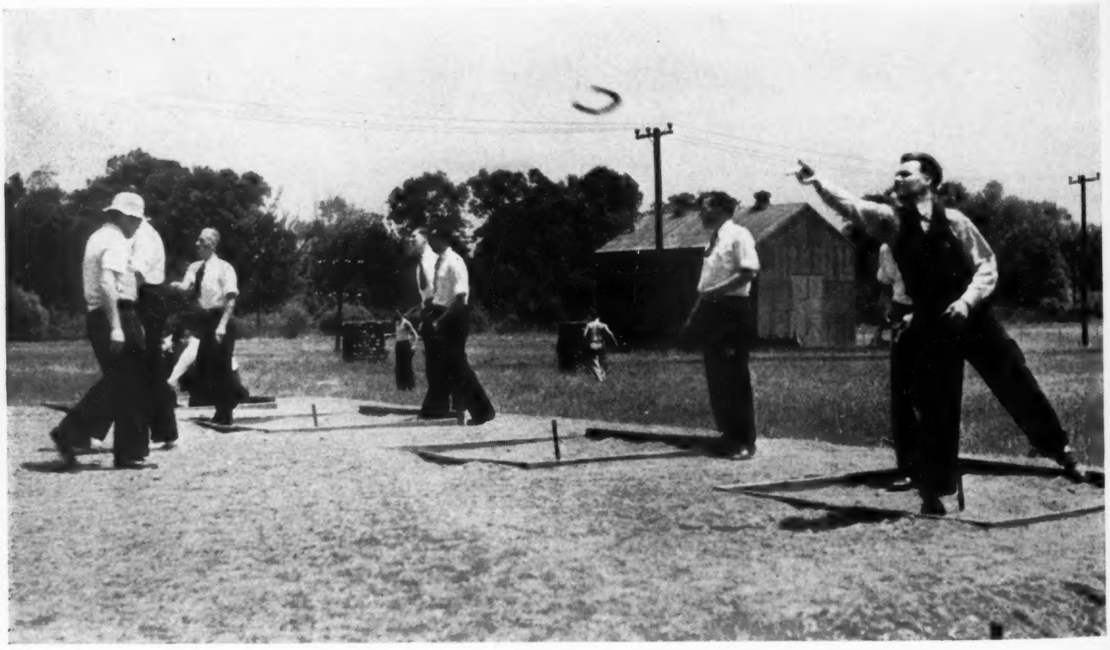
J. P. Radcliff has been assisting in television tests on the Minneapolis-Stevens Point system. He has also been concerned with testing methods for maintaining the coaxial terminals.

R. E. Crane, G. H. Huber, B. A. Fairweather and R. W. Marshall have been in Philadelphia and Princeton for the New York-Philadelphia trial of coaxial terminal equipment.

H. B. Brehm, J. J. Gilbert, and Q. E. Greenwood at Manahawkin, N. J., conducted tests on samples of submarine cable.

W. C. F. Farnell, with R. T. Barrett of the A. T. & T., visited Cleveland to confer with The Ohio Bell Telephone Company on historical matters. Mr. Farnell also went to Detroit in connection with museum exhibits for the Edison Institute.

G. F. Heuerman and W. M. Hill appeared before the Board of Appeals at the Patent Office on applications for patent.



Noontime at Whippany

TELEPHONE SYSTEMS DRAWINGS

LAST year 8600 new drawings were completed by the Systems Development drafting group, and added to the 230,000 already held in the department's vaults. The production and handling of this great store of engineering data is a major problem. Suggested improvements in method have been carefully studied and frequently adopted; some of them have been described in earlier issues of the RECORD. The accompanying photographs review the current method of handling Systems drawings.

The inception of a new drawing is shown above: an engineer is explaining to a draftsman the features of a new piece of equipment which he wants laid out

Many "new" drawings are actually old drawings with changes, additions or deletions. If the changes are not too considerable, it is economical to make a "Van Dyke negative," opaque the parts to be redrawn, and then draw in the new material on a photographically reproduced tracing

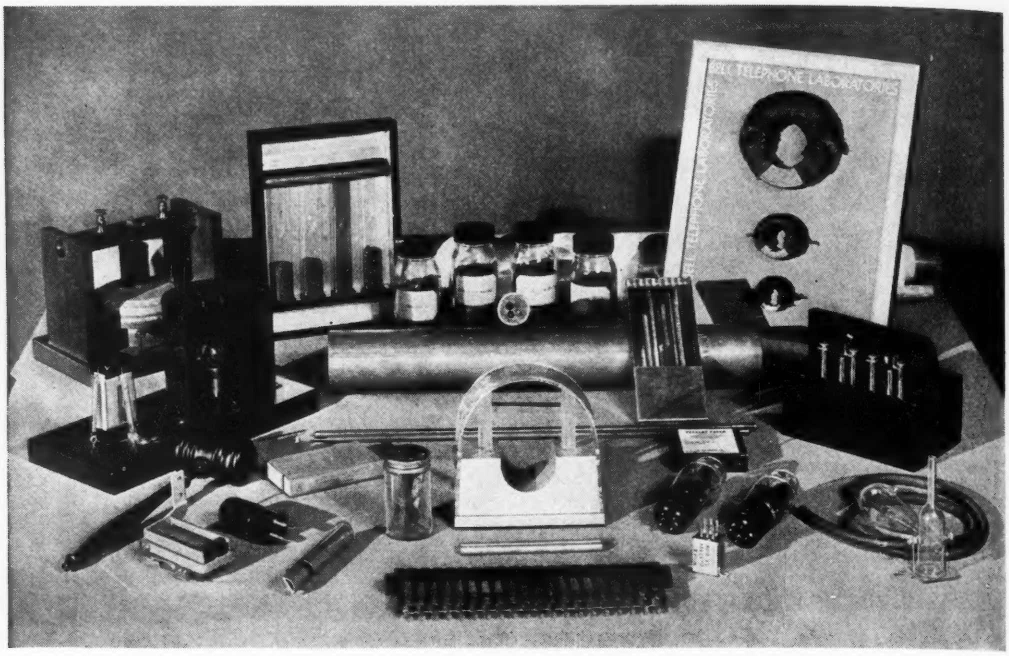
Inking in the lines on an assembly drawing which shows the elements of a telephone equipment design. The drawing is first laid out in pencil to get an orderly arrangement; then the lines may or may not be inked in, according to the use to which the drawing is to be put

Lettering is a specialized job in itself; it is usually done with the help of celluloid templates that assure uniformity in the size and shape of lettering. Uniformity of line weight is obtained by using pens of specified size

To visualize equipment that has been designed but not yet built, a three-dimensional effect can be given to an engineering sketch. Shading is painted in by hand or blown in with an airbrush

Typing is faster than hand lettering; when there is need on a drawing for a long list of apparatus, standards or the like, the material is typed on white paper and then transferred to tracing cloth by a photographic method

A section of one of the vaults where almost a quarter-million tracings are stored. The vaults are protected from fire by an overhead sprinkler system; and each tracing drawer is protected from sprinkler water by an individual waterproof curtain



Bell Laboratories Lecture Equipment

CIVIC organizations and other groups of thoughtful purpose always have need of program material. They have learned to look to their Telephone Company as a source; the company on its part is glad to accept invitations, since each is an opportunity to meet its subscribers and make new friends.

Although these groups assemble primarily for what they hear, they are intrigued by demonstrations which they can see. With this in mind C. D. Hanscom of the Laboratories' Bureau of Publication, coöperating with J. O. Perrine, Assistant Vice President of the A. T. & T. Co., recently assembled a variety of equipment for use in Bell System lectures. Only simple demonstrations were chosen, for simplicity has been found to be no detriment to interest and entertainment value.

One of the most unusual demonstrations is a Rochelle salt crystal which flashes a neon lamp when hit with a gavel. This illustrates how a change in mechanical dimensions, caused by a blow from the gavel, generates momentary voltages of considerable magnitude by the piezoelectric effect.

A bar of steel (a permanent magnet) floating in mid-air demonstrates the power of modern magnets. A permanent magnet concealed in the base of the apparatus repels the bar, and holds it up against the force of gravity; a full package of cigarettes can even be supported in addition to the bar. There are also permalloy rods in the collection which are so permeable that they are magnetized by the earth's field when held pointing north at or near the angle of declination. This is demonstrated by their ability to attract and hold short

pieces of permalloy tape. For convenience in carrying, these rods are made in two parts which are screwed together for a demonstration. Two similar short rods, one of steel, which is magnetized, and the other of soft iron can be used to test the ingenuity of the audience by asking them to determine from the action of the rods on each other which is magnetized.

Decreased size of loading coils, made possible by Bell Laboratories researches on magnetic alloys, is illustrated by a display board on which are mounted a coil with an iron dust core, a much smaller coil of equal efficiency with a permalloy core and a still smaller one with the same electrical characteristic whose core is molybdenum permalloy. Samples of the 2121-pair cable for exchange areas are included; also a piece of the Minneapolis-Stevens Point coaxial cable which transmits frequencies of several million vibrations per second.

How coal becomes transmitter carbon is illustrated by samples of granulated coal and carbon in bottles or tubes which show several stages in the series of crushings, screenings and roastings involved in its manufacture.

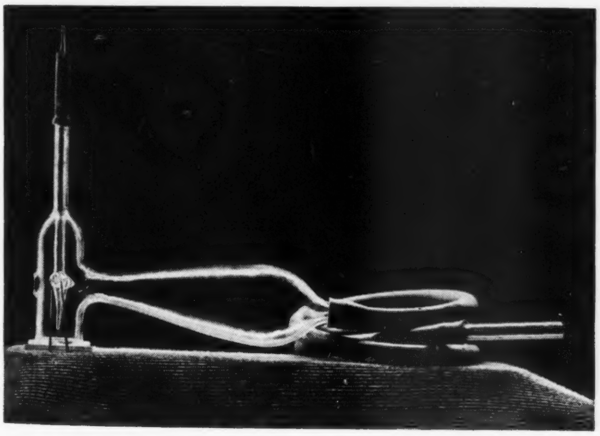


Fig. 1—Minute samples of dust are collected for micro-analysis by sucking them onto a microscope slide with the "impinger"

Microchemical methods of detecting minute impurities and thin films of corrosion are required in analyzing some telephone materials. The ex-

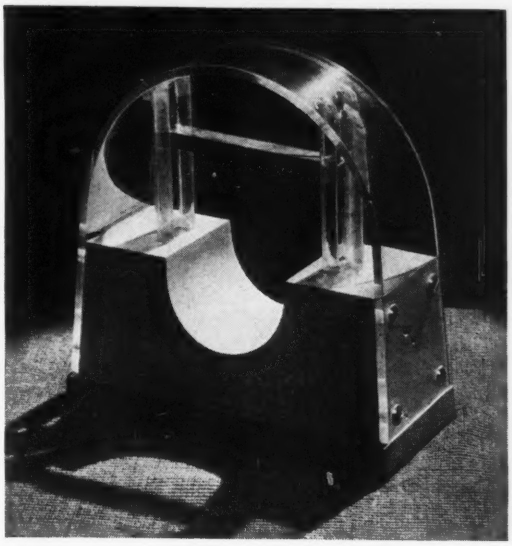


Fig. 2—The repulsion of a strong permanent magnet concealed in the base of this apparatus supports the magnetized "wobbly bar" against the force of gravity

treme sensitivity of these tests is illustrated by pressing a moistened paper of cadmium diethyl-dithiocarbamate paper against the fingers of a person who has held a penny. Discoloration of the paper shows where traces of copper have remained on the fingers.

Minute samples of dust are sometimes collected for microanalysis from telephone apparatus by an impinger which sucks the dust from very small areas and collects it on a microscope slide. This instrument is included among the exhibits for lecture use.

There are also grasshopper fuses which indicate when a circuit has been blown in central offices. A colored glass

bead flips out and an alarm sounds. Their acrobatic behavior is demonstrated by mounting them on a box which contains a dry battery to blow the fuses, as shown directly below.

Telephone poles are protected against decay by treating them with preservatives. A collection of borings taken from treated poles shows that the distance the preservative penetrates differs greatly with the kind of wood. The value of wood preservatives is illustrated by the difference in decay of treated and untreated blocks which were put in bottles in the laboratory and inoculated with destructive fungi.

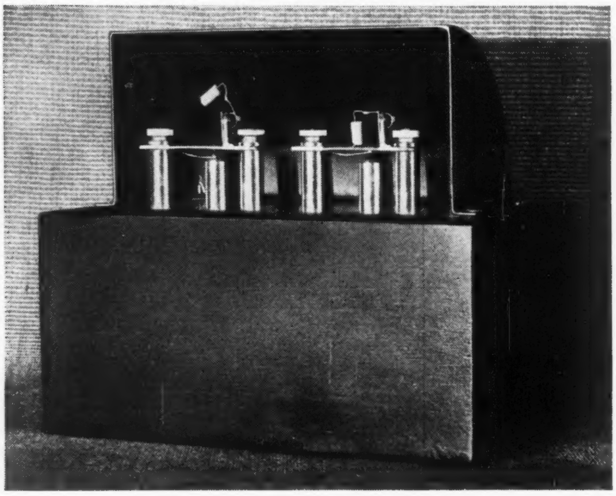


Fig. 3—Grasshopper fuses, which flip out a colored glass when a circuit blows in central offices, are demonstrated by blowing the fuses with current from a dry battery concealed in the box

To illustrate the complexity of the equipment required in crossbar dial offices, there was prepared a roll of cloth blueprints which shows the circuits and associated information for a single unit of such a system. The roll is over fifty feet long.

When linemen call a central office from the field they sometimes use a whistle that emits a 1,000-cycle tone with interruptions twenty times a second. When held near their handset transmitter this whistle sends over the line the signal required to operate a ringer in the central office. These whistles are recommended for the demonstration kit.

The care taken to obtain compactness in the design of switchboard apparatus when space is at a premium, is illustrated by a strip of switchboard lamp sockets. An example of decreased maintenance requirements and lower cost is the substitution of a gas-filled tube in the combined handset for the relay previously used to produce the ringing current.

Copper oxide rectifiers are used as modulators and demodulators in some carrier-frequency circuits instead of vacuum tubes. They cost less, require no servicing and last indefinitely. For comparison a D-98914 varistor and two 101F vacuum tubes are recommended. One of these varistors does the work of two vacuum tubes in carrier systems.

Manholes are occasionally contaminated with carbon monoxide by accidental leaks from illuminating gas mains. To protect workmen against injury from this source, there is provided a detector which consists of a glass ampule containing palladium. On breaking in absorbent cotton the liquid turns dark if the gas is present.

A replica of Bell's original telephone is usually included with the exhibits.

Instructions have been prepared. Special items and those requiring special instructions to demonstrate them are obtained from the Laboratories. Standard items can be ordered directly from Western Electric.

Transmission Talk

By M. D. BRILL
Transmission Apparatus Development

WHENEVER an American makes or does something new, he tries to invent a new expression to describe it. And as Yankee ingenuity is proverbial our language is constantly being enriched by a stream of freshly coined words. The larger part of them are soon forgotten; but others—the better ones—survive because they carry a meaning that cannot otherwise be expressed so easily or so well.

An especially good environment for growing words is any profession that involves tools or operations peculiar to itself. Expressions come into use which are particularly apt for the pursuit at hand, and yet are bewildering to the uninitiated, until at length an industry has not only its "tools of the trade" but also its "talk of the trade."

The communications art has its share of expressions almost meaningless to the layman, but entirely clear to those working in that field. Many of them have been compiled in a "Glossary for Telephone Transmission" by K. S. Johnson, but as time goes on new ones are coined and take their places in the language. In the rather restricted field of carrier-transmission networks some of the recent expressions which enjoy considerable usage are "roof" filter, "cellar" filter, "frogging" filter, "comb" filter, and "pimple" filter. The transmission networks referred to are not new types, but the new descriptive phrases indicate the function of the networks in a transmission system in a pointed manner that the older generic classifications such as "low-pass" or "high-pass" filter could not equal. Definitions of these filters in the thumbnail sketch style of the "Glossary" may prove useful to those interested in the communications art.

A *"roof" filter* is a low-pass filter used in a carrier telephone repeater to limit the upper frequency end of the transmitted band to its prescribed useful range. It eliminates high-frequency disturbances which might cause noise or crosstalk in adjacent systems.

A *"cellar" filter* is a high-pass filter used in a carrier telephone repeater to limit the lower-frequency end of the transmitted band. Except for the difference in the frequency end which it limits, its function is the same as that of a roof filter.

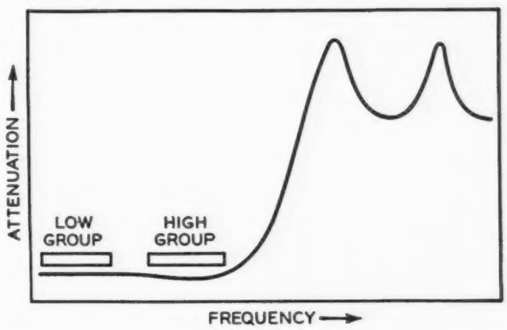


Fig. 1—"Roof" filter, typical characteristic

"Frogging" filter: The term "frogging" derives from the expression "frog" in railway engineering which refers to the mechanical device permit-

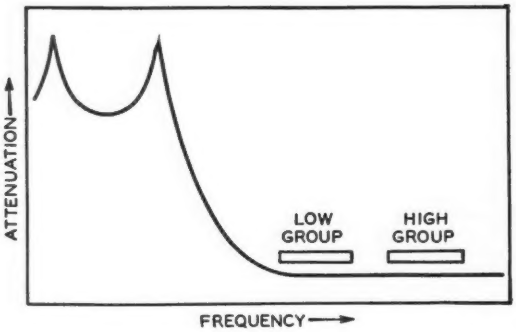


Fig. 2—"Cellar" filter

ting wheels on one rail of a track to cross an intersecting rail. In telephone transmission terminology, "frogging" means the transfer of the intelligence-bearing frequencies of an open-wire carrier system from a particular line

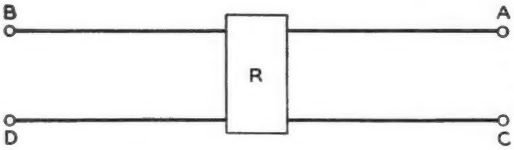


Fig. 3—"Frogging" may be required for certain arrangements of carrier lines that use common repeaters

entering a repeater to a different line leaving the repeater. The geographical arrangement of the carrier telephone facilities occasionally makes this necessary, and the basic situation is illustrated in Figure 3. Suppose that cities A and B are the terminals of a type-C carrier telephone system operating over line ARB, and R is a repeater point. Similarly, suppose C and D to be terminals of another type-C system operating over line CRD, and R to be a repeater point for this system likewise. If it is desired to add a type-J carrier telephone system between cities A and D, and a type-J system between cities C and B without constructing additional open-wire lines, then such systems must switch from one line to the other in passing through repeater point R. This would be known as a "frog" of two type-J systems. Additional transmission apparatus is, of course, necessary to effect this frog, and one such piece of apparatus is known as a "frogging" filter. This filter is of either the "low-pass" or "high-pass" type and serves to eliminate the increased crosstalk at the repeater resulting from the frogging process. Frogging filters may be, but are not necessarily, roof or cellar filters.

A *"pimple" filter* augments the loop loss of a directional filter set over small frequency bands where deficiencies in loss exist for some unusual service conditions. Such filters possess high discrimination over small frequency ranges and derive their name from the resemblance of their attenuation characteristic to what Webster calls "a small, pointed elevation of the skin"—in short, a pimple. In their simplest form, they consist merely of one-mesh resonant circuits; in more complicated forms they may be conventional band-elimination filters.

A *"comb" filter* is used at the terminals of a carrier telephone system to prevent a leak of the unmodulated carriers to the line. These filters assist the balanced modulators in this function, and make frequent checks of modulator balance unnecessary. In

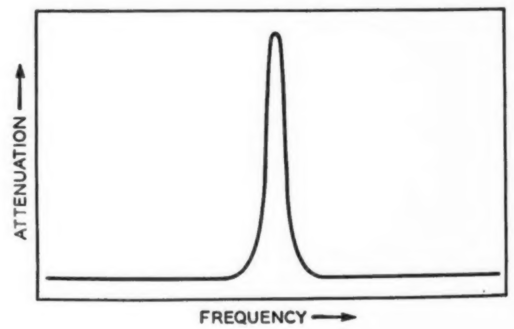


Fig. 4—"Pimple" filter

the type-K carrier telephone system they consist of a parallel connection of quartz crystals, each crystal cut for a particular carrier frequency. The crystals introduce extremely sharp attenuation peaks at their respective resonant frequencies, hence the descriptive name "comb."

The word "filter" is itself an excellent example of an expression whose meaning has been extended by new usage. Derived from the Latin *feltrum*, meaning "felt," or "fulled wool," which was used to strain liquors, it originally referred to any material or device employed to separate a liquid from particles of solid held in suspension. Chosen by transmission engineers to describe a circuit that suppresses certain frequencies and passes others, it has served its purpose with complete satisfaction to all concerned.

Many of the best "new" words, like "filter," are not new at all except in meaning. "Frog," referred to above, is another good example. The railroad device so called was given the name because it looked like a frog. This is a pure Americanism; in England a railroad frog is a "crossing." Other neologisms are newly meaningful combinations of old words, many of them extremely vivid, like "cloud-burst," "roughneck," "blowout," "stuffed-shirt" and "brass hat." Genuinely new words are comparatively rare,

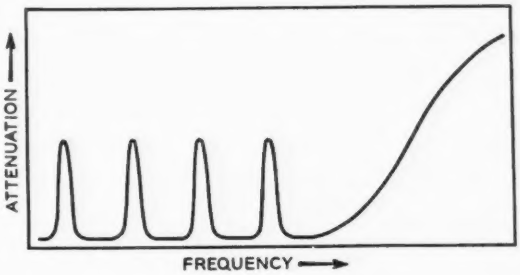


Fig. 5—"Comb" filter

and many of them are likely to remain synthetic. To take familiar examples, "vodas," "compandor" and "codan" all still seem to creak at the joints. "Musa" is better; and although it still lingers below the salt, the best of the Bell System product to date is undoubtedly the cableman's name for the 108A amplifier: "bliffy-sniffer."

Secretarial Key Equipment Using Neon Signals

TO ANSWER several telephone lines at a central point where the simplest secretarial arrangement meets the customer's needs, the 103A key equipment has been developed. It differs from other key boxes in that the signal lamps are neon tubes with cold cathodes. They require no auxiliary apparatus or power supply. The box contains all of the equipment except the telephone set and an audible signal which is common to all of the lines. Each lamp gives a visual signal when the associated line is rung and it also serves in place of a relay to sound the common audible signal. The neon lamp has three electrodes. When ringing current is applied to the two which are connected to the tip and ring of the line the gas in the tube ionizes, thereby providing a conducting path to the third electrode and thence through the audible signal to ground.

To pick up the calling line the two-way locking key, which is associated with the lighted lamp, is operated in the direction of this lamp. The turn-button key shown at the upper right-hand side of the box connects and disconnects the audible signal.

This equipment is available with capacities for ten and twenty lines and it may be multipled for operation from two locations. There are several types of ringing supply and this single secretarial pick-up can be used or adapted for use with most of them.

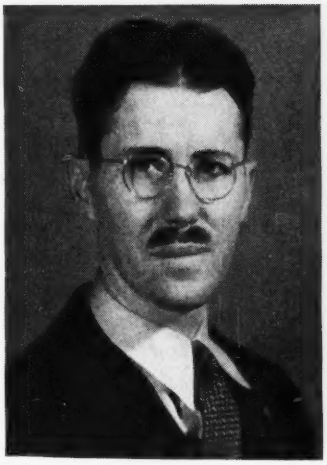
Contributors to this Issue

D. E. TRUCKSESS received a B.S. degree from Pennsylvania State College in 1926, and joined the Technical Staff of the Laboratories in the same year. With the Systems Development Department he has been chiefly engaged in the development of power apparatus. Recently he has given particular attention to the development of regulated rectifiers.

D. E. Trucksess

D. B. PENICK came to the Engineering Department of the Western Electric Company in 1924, where he worked on special problems in the development of vacuum tubes. In 1937 he transferred to the Systems Development Department and has since been engaged in development work on carrier telephone terminals. Mr. Penick received his B.S. degree in Electrical Engineering from the University of Texas in 1923 and a B.A. from the same institution the following year. In 1927 he received an M.A. from Columbia University.

M. D. BRILL was graduated from Columbia University in 1928 with the B.A. degree. After a year of graduate work in physics and engineering, he joined the Apparatus Development Department of the Laboratories in the summer of 1929, returning to Columbia in the fall to complete his work for the M.A. degree which he received in 1930. He then returned to the transmission networks group of the Laboratories. Subsequently, he transferred to the Radio Development Department where he was associated with the development of aircraft receivers. He then returned to the networks group



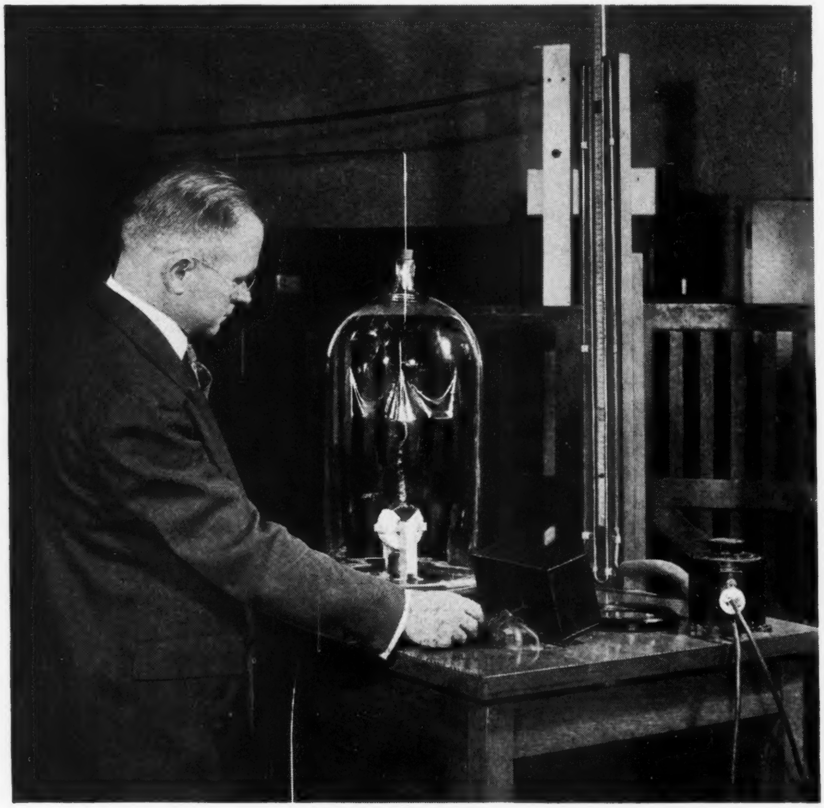
D. B. Penick

M. D. Brill

A. S. Martins

where he has engaged in the study and development of filters, equalizers and networks for telegraph, voice frequency, program, and carrier-frequency systems.

A. S. Martins entered these Laboratories in 1928 and shortly afterward became a technical assistant in the Systems Development Department. He has completed the Laboratories' student engineering course and is at present attending classes at the Polytechnic Institute of Brooklyn from which he expects to receive a degree of B.S. in Electrical Engineering next year. In 1936 he transferred to the step-by-step systems laboratory group where he has been engaged mainly with problems relating to pulsing of step-by-step systems circuits.



Testing at Reduced Air Pressures

Among the problems encountered in the development of communication equipment for aircraft has been the design of transformers of light weight to deliver high a-c potentials at high altitudes. Special precautions must be taken to avoid flashovers in insulating such transformers because the dielectric strength of air is markedly lower at high altitudes than at sea level. In studying the transformers in the laboratory the low atmospheric pressures encountered in flight have to be simulated. This is accomplished by putting them under a bell jar from which the air is exhausted by a vacuum pump. The air pressure is measured with a mercury manometer and is held at the desired value while tests are made on the dielectric strength of the insulation